

## SEQUENCE LISTING

IAP20 Rec'd PCT/PTO 11 APR 2006

<110> The Provost, Fellows and Scholars of the Holy and Undivided  
Trinity of Queen Elizabeth, near Dublin

<120> Adenylate cyclase (CyaA) toxin in the treatment and/or  
prophylaxis of immune-mediated disorder

<130> TRI202/C

<160> 18

<170> PatentIn version 3.3

<210> 1

<211> 10429

<212> DNA

<213> Bordetella pertussis - A-iAC-CyaA pNM2 plasmid DNA

<400> 1

ctcgagaaat cataaaaaat ttatttgctt tgtgagcgga taacaattat aatagattca  
60

attgtgagcg gataacaatt tcacacagaa ttcattaaag aggagaaatt aactatgaga  
120

ggatcgcatc accatcacca tcacggatcc gcatgagcgc tcggtaccat gcagcaatcg  
180

catcaggctg gttacgcaaa cgccgacgac cgggagctctg gcatccccgc agccgtactc  
240

gatggcatca aggcctgggc gaaggaaaaa aacgccacat tgatgttccg cctgggtcaac  
300

ccccattcca ccagcctgat tgccgaaggg gtggccacca aaggattggg cgtggccgac  
360

gcgggatccg attggggggt gcaggcgggc tacattcccg tcaaccgaa tctttccaaa  
420

ctgttcggcc gtgcgccga ggtgatcgcg cgggccgaca acgacgtcaa cagcagcctg  
480

gcgcatggcc ataccgcggt cgacctgacg ctgtcgaaag agcggcttga ctatctcgcg  
540

caagcgggac tggtcaccgg catggccgat ggcgtggctg cgagcaacca cgcaggctac  
600

gagcagttcg agtttcgct gaaggaaacc tcggacgggc gctatgccgt gcagtatcgc  
660

cgcaagggcg gcgacgattt cgaggcggtc aaggtgatcg gcaatgccgc cggatttcca  
720

ctgacggcgg atatcgacat gttcgccatt atgccgcatc tgtccaactt ccgcgactcg  
780

gcgcgcagtt cggtgaccag cggcgattcg gtgaccgatt acctggcgcg cagcggcgcg  
840

gccgccagcg aggccacggg cggcctggat cgcgaacgca tcgacttggt gtggaaaatc  
900

gctcgcgccg gcgcccgttc cgcagtgggc accgaggcgc gtcgccagtt ccgctacgac

960

ggcgacatga atatcggcgt gatcacgat ttcgagctgg aagtgcgcaa tgcgctgaac  
1020

aggcggggcg acgccgtcgg cgcgaggac gtgggccagc atggcactga gcagaacaat  
1080

cctttcccg aggagatga gaagattttc gtcgtatcgg ccaccggtga aagccagatg  
1140

ctcacgcgcg ggcaactgaa ggaatacatt ggccagcagc gcggcgaggg ctatgtcttc  
1200

tacgagaacc gtgcatacgg cgtggcgggg aaaagcctgt tcgacgatgg gctgggagcc  
1260

gcgcccggcg tgccgagcgg acgttcgaag ttctcgccgg atgtactgga aacggtgccg  
1320

gcgtcacccg gattgcggcg gccgtcgctg ggcgagtggt aacgccagga ttccggctat  
1380

gacagccttg atgggggtgg atcgcgatcg ttctcggttg gcgaggtgtc cgacatggcc  
1440

gccgtggaag cggcggaact ggaaatgacc cggcaagtct tgcacgccgg ggcgcggcag  
1500

gacgatgccg agccgggcgt gagcgtgctg tcggcgcaact gggggcagcg ggcgctgcag  
1560

ggcgcccagg cgggtggcggc ggcgagcgg ctggttcatt ccattgccct gatgacgcaa  
1620

ttcggccggg cgggttcac caacacgccg caggaagcgg cctcgtgtc ggcggccgtg  
1680

ttcggttg gcgaggccag cagcgccgtg gccgaaaccg tgagcggttt tttccgagg  
1740

tttcgcgct gggccggcgg tttcggcgtg gctggcgggc cgatggcgct gggaggcggc  
1800

atcgccgcgg ccgttggcgc cgggatgtcg ttgaccgatg acgcgccggc cggacagaag  
1860

gccgcgccg gcgccgagat cgcgctgcag ttgacagggt gaacggtcga gctggcttct  
1920

tccatcgct tggcgctggc cgcggcgcg gccgtgacca gcggcttgca ggtggccggg  
1980

gcgtcgccg gggcggtgc cggcgattg gcccgggcgc tcagtcccat ggagatctac  
2040

ggcctggtgc agcaatcgca ctatgcggat cagctggaca agctggcgca ggaatcgagc  
2100

gcatacgtt acgagggcga cgccttgctg gccagctgt atcgcgacaa gacggccggc  
2160

gagggcgccg tcgccggcgt ctccgccgtc ctgagcacgg tggggcgggc ggtgtcgatc  
2220

gccgcggcgg ccagcgtggt aggggccccg gtggcggttg tcacttcctt gctgaccggg

2280

gctctcaacg gcatcctgcg cggcgtgcag cagcccatca tcgaaaagct ggccaacgat  
2340

tacgctcgca agatcgacga gctgggcggg ccgcaagcgt acttcgagaa aaacctgcag  
2400

gcgcgtcacg aacaactggc caattcggac ggcctacgga aaatgctggc cgacctgcag  
2460

gccggttga acgccagcag cgtgatcggg gtgcagacga cagagatctc caagtcggcg  
2520

ctcgaactgg ccgccattac cggcaacgcg gacaacctga aatccgtcga cgtgttcgtg  
2580

gaccgcttcg tccagggcga gcggtggcc gccagccgg tggctctcga cgtcgccgcc  
2640

ggcggcatcg atatcgccag ccgcaagggc gagcggccgg cgtgacgtt catcacgccg  
2700

ctggccgcgc caggagaaga gcagcgccgg cgcacgaaaa cgggcaagag cgaattcacc  
2760

acattcgtcg agatcgtggg caagcaggac cgctggcgca tccgggacgg cgcggccgac  
2820

accaccatcg atctggccaa ggtggtgtcg caactggtcg acgccaatgg cgtgctcaag  
2880

cacagcatca aactggatgt gatcggcgga gatggcgatg acgtcgtgct tgccaatgct  
2940

tgcgcgatcc attatgacgg cggcgcgggc accaacacgg tcagctatgc cgccttgggt  
3000

cgacaggatt ccattaccgt gtccgccgac ggggaacgtt tcaacgtgcg caagcagttg  
3060

aacaacgcca acgtgtatcg cgaaggcgtg gctaccacga caaccgccta cggcaagcgc  
3120

acggagaatg tccaataccg ccatgtcgag ctggcccgtg tcgggcaagt ggtggaggtc  
3180

gacacgctcg agcatgtgca gcacatcatc ggcggggccc gcaacgattc gatcaecggc  
3240

aatgcgcacg acaacttcct agccggcggg tcgggcgacg acaggctgga tggcggcgcc  
3300

ggcaacgaca ccctggttgg cggcgagggc caaaacacgg tcatcgggcg cgcggcgac  
3360

gacgtattcc tgcaggacct gggggtatgg agcaaccagc tcgatggcgg cgcgggcgtc  
3420

gataccgtga agtacaacgt gcaccagcct tccgaggagc gcctcgaacg catgggagac  
3480

acgggcatcc atgccgatct tcaaaagggc acggtcgaga agtggccggc cctgaacctg  
3540

ttcagcgtcg accatgtcaa gaatatcgag aatctgcacg gctccgcct aaacgaccgc

3600

atcgccggcg acgaccagga caacgagctc tggggccacg atggcaacga cagatacgc  
3660

ggccggggcg gcgacgacat cctgcgcggc ggcctgggcc tggacacgct gtatggcgag  
3720

gacggcaacg acatcttcct gcaggacgac gagaccgtca gcgatgacat cgacggcggc  
3780

gcggggctgg acaccgtcga ctactccgcc atgatccatc caggcaggat cgttgcgcg  
3840

catgaatacg gcttcgggat cgaggcggac ctgtccaggg aatgggtgcg caaggcgtcc  
3900

gcgctggggcg tggactatta cgataatgtc cgcaatgtcg aaaacgtcat cggtagcagc  
3960

atgaaggatg tgctcatcgg cgacgcgcaa gccaatacc tgatgggcca gggcgcgac  
4020

gataccgtgc gcggcggcga cggcgatgat ctgctgttcg gcggcgacgg caacgacatg  
4080

ctgtatggcg acgcggcaa cgacaccctc tacggggggc tgggcgacga tacccttgaa  
4140

ggcggcgcgg gcaacgattg gttcgccag acgcaggcgc gcgagcatga cgtgctgcgc  
4200

ggcgagatg ggggtggatac cgtcgattac agccagaccg gcgcgcatgc cggcattgcc  
4260

gcgggtcgca tcgggctggg catcctggct gacctgggcg ccggccgcgt cgacaagctg  
4320

ggcgaggccg gcagcagcgc ctacgatacg gtttcgggta tcgagaacgt ggtgggcacg  
4380

gaactggccg accgcatac gggcgatgcg caggccaacg tgctgcgcgg cgcgggtggc  
4440

gccgacgtgc ttgcgggcgg cgagggcgac gatgtgctgc tgggcggcga cggcgacgac  
4500

cagctgtcgg gcgacgccgg acgcgatcgc ttgtacggcg aagccggtga cgactggttc  
4560

ttccaggatg ccgccaatgc cggcaatctg ctcgacggcg gcgacggccg cgataccgtg  
4620

gatttcagcg gcccgggccg gggcctcgac gccggcgcaa agggcgtatt cctgagcttg  
4680

ggcaaggggt tcgccagcct gatggacgaa cccgaaacca gcaacgtgtt gcgcaatata  
4740

gagaacgccg tgggcagcgc gcgtgatgac gtgctgatcg gcgacgcagg cgccaacgtc  
4800

ctcaatggcc tggcgggcaa cgacgtgctg tccggcggcg ctggcgacga tgtgctgctg  
4860

ggcgacgagg gctcggacct gctcagcggc gatgcgggca acgacgatct gttcggcggg

4920

cagggcgatg atacttatct gttcggggtc gggtagggc acgacacgat ctacgaatcg  
4980

ggcggcgcc atgacacat ccgcatcaac gcgggggcgg accagctgtg gttcgcgcgc  
5040

cagggcaacg acctggagat ccgcattctc ggcaccgacg atgcacttac cgtgcacgac  
5100

tggtatcgcg acgccgatca cgggtggaa atcatccatg ccgccaacca ggcggtagac  
5160

caggcaggca tcgaaaagct ggtcgaggca atggcgagc atccggaccc cggcgcgcg  
5220

gcggctgcc cgcggcgcc gcgcgtgcc gacacgtga tgcagtccct ggctgtcaac  
5280

tggcgtgag gatccgagg catgtcatgc ttccgtccgc ccaagcgcc tccctcctca  
5340

atcccaccga cgacttcgcg gcactgggca atattgcctg gctgtggatg aactctccca  
5400

tgcaccgca ctggccggtg catctgctcg caccgaacac gtcgcgcgcg attcaactgg  
5460

gccaatacat tctgctgca tgcaatgacg tgccggttgc atactgcagc tgggccctaa  
5520

tggacgccga caccgaactc tctatgtca tggcgccctc gtcgctgggc gggaaatgcct  
5580

ggaaactgcg cgaccgactg tggatcatcg actggatcg gccattctcg cgcgacgaca  
5640

atcgtgcgt gcgccgcgcg ctggccgaac ggcacccga cagcgtgggc cgttcgctgc  
5700

gcgttcggcg cggcgcgac accgcgcgcg tcaaggagta ccgaggccgc gcgctggacg  
5760

cggccgcac tcgcgcgag ctggaccgct accatgccga actgatogca ggactgocgc  
5820

cgagcaacg cggtacgcg ccgcgaggcc ggggcaccgc ctgaaagctt aattagctga  
5880

gcttggaact ctgttgatag atccagtaat gacctcagaa ctccatctgg atttggtcag  
5940

aacgctcggg tgccgccggg cgttttttat tggtgagaat ccaagctagc ttggcgagat  
6000

tttcaggagc taaggaagct aaaatggaga aaaaaatcac tggatatacc accgttgata  
6060

tatcccaatg gcatcgtaaa gaacattttg aggcatttca gtcagttgct caatgtacct  
6120

ataaccagac cgttcagctg gatattacgg ccttttttaa gaccgtaaag aaaaataagc  
6180

acaagtttta tccggccttt attcacattc ttgccgcct gatgaatgct catccggaat

6240

ttcgtatggc aatgaaagac ggtgagctgg tgatatggga tagtggtcac ccttggtaca  
6300

ccgttttcca tgagcaaact gaaacgtttt catcgctctg gagtgaatac cacgacgatt  
6360

tccggcagtt tctacacata tattcgcaag atgtggcgtg ttacggtgaa aacctggcct  
6420

atttccttaa agggtttatt gagaatatgt ttttcgtctc agccaatccc tgggtgagtt  
6480

tcaccagttt tgatttaaac gtggccaata tggacaactt cttcgcccc gttttcacca  
6540

tgggcaaata ttatacgcaa ggcgacaagg tgctgatgcc gctggcgatt caggttcac  
6600

atgccgtttg tgatggcttc catgtcgga gaatgcttaa tgaattacaa cagtactgcg  
6660

atgagtggca gggcgggcg taatTTTTT aaggcagtta ttggtgccct taaacgcctg  
6720

gggtaatgac tctctagctt gaggcacaa ataaaacgaa aggcctcagtc gaaagactgg  
6780

gcctttcgtt ttatctgttg ttgtcggtg aacgctctcc tgagtaggac aaatccgccc  
6840

tctagattac gtgcagtcga tgataagctg tcaaacaatga gaattgtgcc taatgagtga  
6900

gctaacttac attaattgcg ttgcgctcac tgcccgttt ccagtcggga aacctgtcgt  
6960

gccagctgca ttaatgaatc ggccaacgcg cggggagagg cggtttgct attgggcgc  
7020

aggttggttt ttcttttcac cagtgcagc ggcaacagct gattgccctt caccgcctgg  
7080

ccctgagaga gttgcagcaa gcggtccacg ctggtttgcc ccagcaggcg aaaatcctgt  
7140

ttgatggtgg ttaacggcgg gatataacat gagctgtctt cggtatcgtc gtatcccact  
7200

accgagatat ccgcaccaac gcgcagccc gactcggtaa tggcgcgcat tgcgcccagc  
7260

gccatctgat cgttggaac cagcatcgca gtgggaacga tgcctcatt cagcatttgc  
7320

atggtttgtt gaaaaccgga catggcactc cagtcgcctt cccgttccgc tatcggtga  
7380

atttgattgc gagtgcagata tttatgccag ccagccagac gcagacgcgc cgagacagaa  
7440

cttaatgggc ccgctaacag cgcgatttgc tggtagccca atgcgaccag atgctccacg  
7500

ccagtcgcg taccgtcttc atgggagaaa ataatactgt tgatgggtgt ctggtcagag

7560

acatcaagaa ataacgccgg aacattagtg caggcagctt ccacagcaat ggcacccctgg  
7620

tcatccagcg gatagttaat gatcagccca ctgacgcgtt gcgcgagaag attgtgcacc  
7680

gccgctttac aggcttcgac gccgcttcgt tctaccatcg acaccaccac gctggcacc  
7740

agttgatcgg cgcgagattt aatcgccgcg acaatttgcg acggcgcgtg cagggccaga  
7800

ctggagggtg caacgccaat cagcaacgac tgtttgcccg ccagttgttg tgccacgcgg  
7860

ttgggaatgt aattcagctc cgccatcgcc gttccactt tttcccgct tttcgcagaa  
7920

acgtggctgg cctggttcac cagcgggaa acggtctgat aagagacacc ggcatactct  
7980

gcgacatcgt ataacgttac tggtttcaca ttcaccaccc tgaattgact ctcttcggg  
8040

cgctatcatg ccataccgcg aaaggttttg caccattcga tgggtgcgga atttcgggca  
8100

gcgttgggtc ctggccacgg gtgcgcatga tctagagctg cctcgcgcgt ttcggtgatg  
8160

acggtgaaaa cctctgacac atgcagctcc cggagaacgt cacagcttgt ctgtaagcgg  
8220

atgccgggag cagacaagcc cgtcagggcg cgtcagcggg tgttggcggg tgcggggcg  
8280

cagccatgac ccagtcacgt agcgatagcg gagtgtatac tggttaact atgcggcatc  
8340

agagcagatt gtactgagag tgcaccatat gcggtgtgaa ataccgcaca gatgcgtaag  
8400

gagaaaatac cgcacagcg gctcttcgc ttcctcgcgc actgactcgc tgcgctcgtt  
8460

cgcttcggctg cggcgagcgg tatcagctca ctcaaaggcg gtaatacggg tatccacaga  
8520

atcaggggat aacgcaggaa agaacatgtg agcaaaaggc cagcaaaagg ccaggaaccg  
8580

taaaaaggcc gcgttgctgg cgtttttcca taggctccgc cccctgacg agcatcaca  
8640

aaatcgacgc tcaagtcaga ggtggcgaaa cccgacagga ctataaagat accaggcgtt  
8700

tccccctgga agctccctcg tgcgctctcc tgttcgacc ctgcgcgtta ccggatacct  
8760

gtccgccttt ctcccttcgg gaagcgtggc gctttctcat agtcacgct gtaggtatct  
8820

cagttcggtg taggtcgttc gctccaagct gggctgtgtg cacgaacccc ccgttcagcc

8880

cgaccgctgc gccttatccg gtaactatcg tcttgagtcc aacccggtaa gacacgactt  
8940

atcgccactg gcagcagcca ctggtaacag gattagcaga gcgaggatg taggcggtgc  
9000

tacagagttc ttgaagtggc ggcctaacta cggctacact agaaggacag tatttggtat  
9060

ctgcgctctg ctgaagccag ttaccttcgg aaaaagagtt ggtagctctt gatccggcaa  
9120

acaaaccacc gctggtagcg gtgggttttt tgtttgcaag cagcagatta cgcgcagaaa  
9180

aaaaggatct caagaagatc ctttgatctt ttctacggg tctgacgctc agtgaacga  
9240

aaactcacgt taagggattt tggatcatgag attatcaaaa aggatcttca cctagatcct  
9300

tttaaattaa aatgaagtt ttaaataaat ctaaagtata tatgagtaaa cttggtctga  
9360

cagttaccaa tgcttaatca gtgaggcacc tatctcagcg atctgtctat ttcgttcac  
9420

catagttgcc tgactccccg tcgtgtagat aactacgata cgggagggct taccatctgg  
9480

ccccagtgc gcaatgatac cgcgagaccc acgctcaccg gctccagatt tatcagcaat  
9540

aaaccagcca gccggaagg cgcgagcag aagtggctct gcaactttat ccgcctccat  
9600

ccagtctatt aattgttgcc gggaagctag agtaagtagt tcgccagtta atagtttgcc  
9660

caacgttggt gccattgcta caggcatcgt ggtgtcacgc tcgtcggttg gtatggcttc  
9720

attcagctcc ggttcccaac gatcaaggcg agttacatga tccccatgt tgtgcaaaaa  
9780

agcggtttagc tccttcggtc ctccgatcgt tgtcagaagt aagttggccg cagtgttacc  
9840

actcatgggt atggcagcac tgcataattc tcttactgtc atgccatccg taagatgctt  
9900

ttctgtgact ggtgagtact caaccaagtc attctgagaa tagtgtatgc ggcgaccgag  
9960

ttgtctttgc ccggcgtaaa tacgggataa taccgcgcca catagcagaa ctttaaaagt  
10020

gctcatcatt ggaaaacgtt cttcggggcg aaaactctca aggatcttac cgctgttgag  
10080

atccagttcg atgtaacca ctcgtgcacc caactgatct tcagcatctt ttactttcac  
10140

cagcgtttct gggtagagcaa aaacaggaag gcaaaatgcc gcaaaaaagg gaataagggc



10200

gacacggaaa tgttgaatac tcatactctt cctttttcaa tattattgaa gcatttatca  
10260

gggttattgt ctcattgagcg gatacatatt tgaatgtatt tagaaaaata aacaaatagg  
10320

ggttccgcgc acatttcccc gaaaagtgcc acctgacgtc taagaaacca ttattatcat  
10380

gacattaacc tataaaaaata ggcgtatcac gaggcccttt cgtcttcac  
10429

&lt;210&gt; 2

&lt;211&gt; 185

&lt;212&gt; PRT

&lt;213&gt; Bordetella pertussis - A-iAC CyaC

&lt;400&gt; 2

Met Leu Pro Ser Ala Gln Ala Pro Ser Leu Leu Asn Pro Thr Asp Asp  
1 5 10 15

Phe Ala Ala Leu Gly Asn Ile Ala Trp Leu Trp Met Asn Ser Pro Met  
20 25 30

His Arg Asp Trp Pro Val His Leu Leu Ala Arg Asn Thr Leu Ala Pro  
35 40 45

Ile Gln Leu Gly Gln Tyr Ile Leu Leu Arg Cys Asn Asp Val Pro Val  
50 55 60

Ala Tyr Cys Ser Trp Ala Leu Met Asp Ala Asp Thr Glu Leu Ser Tyr  
65 70 75 80

Val Met Ala Pro Ser Ser Leu Gly Gly Asn Ala Trp Asn Cys Gly Asp  
85 90 95

Arg Leu Trp Ile Ile Asp Trp Ile Ala Pro Phe Ser Arg Asp Asp Asn  
100 105 110

Arg Ala Leu Arg Arg Ala Leu Ala Glu Arg His Pro Asp Ser Val Gly  
115 120 125

Arg Ser Leu Arg Val Arg Arg Gly Gly Asp Thr Ala Arg Val Lys Glu  
130 135 140

Tyr Arg Gly Arg Ala Leu Asp Ala Ala Ala Thr Arg Ala Gln Leu Asp  
145 150 155 160

Arg Tyr His Ala Glu Leu Ile Ala Gly Leu Arg Ala Ser Asn Gly Gly  
165 170 175

Tyr Ala Pro Arg Gly Arg Gly Thr Ala  
180 185

<210> 3  
<211> 1724  
<212> PRT  
<213> Bordetella pertussis -- iAC-CyaA  
<400> 3

Met Arg Gly Ser His His His His His His Gly Ser Ala Cys Glu Leu  
1 5 10 15

Gly Thr Met Gln Gln Ser His Gln Ala Gly Tyr Ala Asn Ala Ala Asp  
20 25 30

Arg Glu Ser Gly Ile Pro Ala Ala Val Leu Asp Gly Ile Lys Ala Val  
35 40 45

Ala Lys Glu Lys Asn Ala Thr Leu Met Phe Arg Leu Val Asn Pro His  
50 55 60

Ser Thr Ser Leu Ile Ala Glu Gly Val Ala Thr Lys Gly Leu Gly Val  
65 70 75 80

Ala Ala Ala Gly Ser Asp Trp Gly Leu Gln Ala Gly Tyr Ile Pro Val  
85 90 95

Asn Pro Asn Leu Ser Lys Leu Phe Gly Arg Ala Pro Glu Val Ile Ala  
100 105 110

Arg Ala Asp Asn Asp Val Asn Ser Ser Leu Ala His Gly His Thr Ala  
115 120 125

Val Asp Leu Thr Leu Ser Lys Glu Arg Leu Asp Tyr Leu Arg Gln Ala  
130 135 140

Gly Leu Val Thr Gly Met Ala Asp Gly Val Val Ala Ser Asn His Ala  
145 150 155 160

Gly Tyr Glu Gln Phe Glu Phe Arg Val Lys Glu Thr Ser Asp Gly Arg  
165 170 175

Tyr Ala Val Gln Tyr Arg Arg Lys Gly Gly Asp Asp Phe Glu Ala Val  
180 185 190

Lys Val Ile Gly Asn Ala Ala Gly Ile Pro Leu Thr Ala Asp Ile Asp  
195 200 205

Met Phe Ala Ile Met Pro His Leu Ser Asn Phe Arg Asp Ser Ala Arg  
210 215 220

Ser Ser Val Thr Ser Gly Asp Ser Val Thr Asp Tyr Leu Ala Arg Thr  
225 230 235 240

Arg Arg Ala Ala Ser Glu Ala Thr Gly Gly Leu Asp Arg Glu Arg Ile  
245 250 255

Asp Leu Leu Trp Lys Ile Ala Arg Ala Gly Ala Arg Ser Ala Val Gly  
260 265 270

Thr Glu Ala Arg Arg Gln Phe Arg Tyr Asp Gly Asp Met Asn Ile Gly  
275 280 285

Val Ile Thr Asp Phe Glu Leu Glu Val Arg Asn Ala Leu Asn Arg Arg  
290 295 300

Ala His Ala Val Gly Ala Gln Asp Val Val Gln His Gly Thr Glu Gln  
305 310 315 320

Asn Asn Pro Phe Pro Glu Ala Asp Glu Lys Ile Phe Val Val Ser Ala  
325 330 335

Thr Gly Glu Ser Gln Met Leu Thr Arg Gly Gln Leu Lys Glu Tyr Ile  
340 345 350

Gly Gln Gln Arg Gly Glu Gly Tyr Val Phe Tyr Glu Asn Arg Ala Tyr  
355 360 365

Gly Val Ala Gly Lys Ser Leu Phe Asp Asp Gly Leu Gly Ala Ala Pro  
370 375 380

Gly Val Pro Ser Gly Arg Ser Lys Phe Ser Pro Asp Val Leu Glu Thr  
385 390 395 400

Val Pro Ala Ser Pro Gly Leu Arg Arg Pro Ser Leu Gly Ala Val Glu  
405 410 415

Arg Gln Asp Ser Gly Tyr Asp Ser Leu Asp Gly Val Gly Ser Arg Ser  
420 425 430

Phe Ser Leu Gly Glu Val Ser Asp Met Ala Ala Val Glu Ala Ala Glu  
435 440 445

Leu Glu Met Thr Arg Gln Val Leu His Ala Gly Ala Arg Gln Asp Asp  
450 455 460

Ala Glu Pro Gly Val Ser Gly Ala Ser Ala His Trp Gly Gln Arg Ala  
465 470 475 480

Leu Gln Gly Ala Gln Ala Val Ala Ala Ala Gln Arg Leu Val His Ala

485                      490                      495  
 Ile Ala Leu Met Thr Gln Phe Gly Arg Ala Gly Ser Thr Asn Thr Pro  
                          500                      505                      510  
 Gln Glu Ala Ala Ser Leu Ser Ala Ala Val Phe Gly Leu Gly Glu Ala  
                          515                      520                      525  
 Ser Ser Ala Val Ala Glu Thr Val Ser Gly Phe Phe Arg Gly Ser Ser  
                          530                      535                      540  
 Arg Trp Ala Gly Gly Phe Gly Val Ala Gly Gly Ala Met Ala Leu Gly  
                          545                      550                      555                      560  
 Gly Gly Ile Ala Ala Ala Val Gly Ala Gly Met Ser Leu Thr Asp Asp  
    565                      570                      575  
 Ala Pro Ala Gly Gln Lys Ala Ala Ala Gly Ala Glu Ile Ala Leu Gln  
    580                      585                      590  
 Leu Thr Gly Gly Thr Val Glu Leu Ala Ser Ser Ile Ala Leu Ala Leu  
    595                      600                      605  
 Ala Ala Ala Arg Gly Val Thr Ser Gly Leu Gln Val Ala Gly Ala Ser  
    610                      615                      620  
 Ala Gly Ala Ala Ala Gly Ala Leu Ala Ala Ala Leu Ser Pro Met Glu  
    625                      630                      635                      640  
 Ile Tyr Gly Leu Val Gln Gln Ser His Tyr Ala Asp Gln Leu Asp Lys  
    645                      650                      655  
 Leu Ala Gln Glu Ser Ser Ala Tyr Gly Tyr Glu Gly Asp Ala Leu Leu  
    660                      665                      670  
 Ala Gln Leu Tyr Arg Asp Lys Thr Ala Ala Glu Gly Ala Val Ala Gly  
    675                      680                      685  
 Val Ser Ala Val Leu Ser Thr Val Gly Ala Ala Val Ser Ile Ala Ala  
    690                      695                      700  
 Ala Ala Ser Val Val Gly Ala Pro Val Ala Val Val Thr Ser Leu Leu  
    705                      710                      715                      720  
 Thr Gly Ala Leu Asn Gly Ile Leu Arg Gly Val Gln Gln Pro Ile Ile  
    725                      730                      735  
 Glu Lys Leu Ala Asn Asp Tyr Ala Arg Lys Ile Asp Glu Leu Gly Gly  
    740                      745                      750

Pro Gln Ala Tyr Phe Glu Lys Asn Leu Gln Ala Arg His Glu Gln Leu  
755 760 765

Ala Asn Ser Asp Gly Leu Arg Lys Met Leu Ala Asp Leu Gln Ala Gly  
770 775 780

Trp Asn Ala Ser Ser Val Ile Gly Val Gln Thr Thr Glu Ile Ser Lys  
785 790 795 800

Ser Ala Leu Glu Leu Ala Ala Ile Thr Gly Asn Ala Asp Asn Leu Lys  
805 810 815

Ser Val Asp Val Phe Val Asp Arg Phe Val Gln Gly Glu Arg Val Ala  
820 825 830

Gly Gln Pro Val Val Leu Asp Val Ala Ala Gly Gly Ile Asp Ile Ala  
835 840 845

Ser Arg Lys Gly Glu Arg Pro Ala Leu Thr Phe Ile Thr Pro Leu Ala  
850 855 860

Ala Pro Gly Glu Glu Gln Arg Arg Arg Thr Lys Thr Gly Lys Ser Glu  
865 870 875 880

Phe Thr Thr Phe Val Glu Ile Val Gly Lys Gln Asp Arg Trp Arg Ile  
885 890 895

Arg Asp Gly Ala Ala Asp Thr Thr Ile Asp Leu Ala Lys Val Val Ser  
900 905 910

Gln Leu Val Asp Ala Asn Gly Val Leu Lys His Ser Ile Lys Leu Asp  
915 920 925

Val Ile Gly Gly Asp Gly Asp Asp Val Val Leu Ala Asn Ala Ser Arg  
930 935 940

Ile His Tyr Asp Gly Gly Ala Gly Thr Asn Thr Val Ser Tyr Ala Ala  
945 950 955 960

Leu Gly Arg Gln Asp Ser Ile Thr Val Ser Ala Asp Gly Glu Arg Phe  
965 970 975

Asn Val Arg Lys Gln Leu Asn Asn Ala Asn Val Tyr Arg Glu Gly Val  
980 985 990

Ala Thr Gln Thr Thr Ala Tyr Gly Lys Arg Thr Glu Asn Val Gln Tyr  
995 1000 1005

Arg His Val Glu Leu Ala Arg Val Gly Gln Val Val Glu Val Asp

1010		1015		1020
Thr Leu Glu His Val Gln His Ile Ile Gly Gly Ala Gly Asn Asp 1025 1030 1035				
Ser Ile Thr Gly Asn Ala His Asp Asn Phe Leu Ala Gly Gly Ser 1040 1045 1050				
Gly Asp Asp Arg Leu Asp Gly Gly Ala Gly Asn Asp Thr Leu Val 1055 1060 1065				
Gly Gly Glu Gly Gln Asn Thr Val Ile Gly Gly Ala Gly Asp Asp 1070 1075 1080				
Val Phe Leu Gln Asp Leu Gly Val Trp Ser Asn Gln Leu Asp Gly 1085 1090 1095				
Gly Ala Gly Val Asp Thr Val Lys Tyr Asn Val His Gln Pro Ser 1100 1105 1110				
Glu Glu Arg Leu Glu Arg Met Gly Asp Thr Gly Ile His Ala Asp 1115 1120 1125				
Leu Gln Lys Gly Thr Val Glu Lys Trp Pro Ala Leu Asn Leu Phe 1130 1135 1140				
Ser Val Asp His Val Lys Asn Ile Glu Asn Leu His Gly Ser Arg 1145 1150 1155				
Leu Asn Asp Arg Ile Ala Gly Asp Asp Gln Asp Asn Glu Leu Trp 1160 1165 1170				
Gly His Asp Gly Asn Asp Thr Ile Arg Gly Arg Gly Gly Asp Asp 1175 1180 1185				
Ile Leu Arg Gly Gly Leu Gly Leu Asp Thr Leu Tyr Gly Glu Asp 1190 1195 1200				
Gly Asn Asp Ile Phe Leu Gln Asp Asp Glu Thr Val Ser Asp Asp 1205 1210 1215				
Ile Asp Gly Gly Ala Gly Leu Asp Thr Val Asp Tyr Ser Ala Met 1220 1225 1230				
Ile His Pro Gly Arg Ile Val Ala Pro His Glu Tyr Gly Phe Gly 1235 1240 1245				
Ile Glu Ala Asp Leu Ser Arg Glu Trp Val Arg Lys Ala Ser Ala 1250 1255 1260				

Leu Gly Val Asp Tyr Tyr Asp Asn Val Arg Asn Val Glu Asn Val  
 1265 1270 1275  
 Ile Gly Thr Ser Met Lys Asp Val Leu Ile Gly Asp Ala Gln Ala  
 1280 1285 1290  
 Asn Thr Leu Met Gly Gln Gly Gly Asp Asp Thr Val Arg Gly Gly  
 1295 1300 1305  
 Asp Gly Asp Asp Leu Leu Phe Gly Gly Asp Gly Asn Asp Met Leu  
 1310 1315 1320  
 Tyr Gly Asp Ala Gly Asn Asp Thr Leu Tyr Gly Gly Leu Gly Asp  
 1325 1330 1335  
 Asp Thr Leu Glu Gly Gly Ala Gly Asn Asp Trp Phe Gly Gln Thr  
 1340 1345 1350  
 Gln Ala Arg Glu His Asp Val Leu Arg Gly Gly Asp Gly Val Asp  
 1355 1360 1365  
 Thr Val Asp Tyr Ser Gln Thr Gly Ala His Ala Gly Ile Ala Ala  
 1370 1375 1380  
 Gly Arg Ile Gly Leu Gly Ile Leu Ala Asp Leu Gly Ala Gly Arg  
 1385 1390 1395  
 Val Asp Lys Leu Gly Glu Ala Gly Ser Ser Ala Tyr Asp Thr Val  
 1400 1405 1410  
 Ser Gly Ile Glu Asn Val Val Gly Thr Glu Leu Ala Asp Arg Ile  
 1415 1420 1425  
 Thr Gly Asp Ala Gln Ala Asn Val Leu Arg Gly Ala Gly Gly Ala  
 1430 1435 1440  
 Asp Val Leu Ala Gly Gly Glu Gly Asp Asp Val Leu Leu Gly Gly  
 1445 1450 1455  
 Asp Gly Asp Asp Gln Leu Ser Gly Asp Ala Gly Arg Asp Arg Leu  
 1460 1465 1470  
 Tyr Gly Glu Ala Gly Asp Asp Trp Phe Phe Gln Asp Ala Ala Asn  
 1475 1480 1485  
 Ala Gly Asn Leu Leu Asp Gly Gly Asp Gly Arg Asp Thr Val Asp  
 1490 1495 1500  
 Phe Ser Gly Pro Gly Arg Gly Leu Asp Ala Gly Ala Lys Gly Val

1505                      1510                      1515  
 Phe Leu Ser Leu Gly Lys Gly Phe Ala Ser Leu Met Asp Glu Pro  
 1520                      1525                      1530  
 Glu Thr Ser Asn Val Leu Arg Asn Ile Glu Asn Ala Val Gly Ser  
 1535                      1540                      1545  
 Ala Arg Asp Asp Val Leu Ile Gly Asp Ala Gly Ala Asn Val Leu  
 1550                      1555                      1560  
 Asn Gly Leu Ala Gly Asn Asp Val Leu Ser Gly Gly Ala Gly Asp  
 1565                      1570                      1575  
 Asp Val Leu Leu Gly Asp Glu Gly Ser Asp Leu Leu Ser Gly Asp  
 1580                      1585                      1590  
 Ala Gly Asn Asp Asp Leu Phe Gly Gly Gln Gly Asp Asp Thr Tyr  
 1595                      1600                      1605  
 Leu Phe Gly Val Gly Tyr Gly His Asp Thr Ile Tyr Glu Ser Gly  
 1610                      1615                      1620  
 Gly Gly His Asp Thr Ile Arg Ile Asn Ala Gly Ala Asp Gln Leu  
 1625                      1630                      1635  
 Trp Phe Ala Arg Gln Gly Asn Asp Leu Glu Ile Arg Ile Leu Gly  
 1640                      1645                      1650  
 Thr Asp Asp Ala Leu Thr Val His Asp Trp Tyr Arg Asp Ala Asp  
 1655                      1660                      1665  
 His Arg Val Glu Ile Ile His Ala Ala Asn Gln Ala Val Asp Gln  
 1670                      1675                      1680  
 Ala Gly Ile Glu Lys Leu Val Glu Ala Met Ala Gln Tyr Pro Asp  
 1685                      1690                      1695  
 Pro Gly Ala Ala Ala Ala Ala Pro Pro Ala Ala Arg Val Pro Asp  
 1700                      1705                      1710  
 Thr Leu Met Gln Ser Leu Ala Val Asn Trp Arg  
 1715                      1720

<210> 4  
 <211> 1724  
 <212> PRT  
 <213> Bordetella pertussis - NA-CyaA  
 <400> 4



Met Arg Gly Ser His His His His His His Gly Ser Ala Cys Glu Leu  
1 5 10 15

Gly Thr Met Gln Gln Ser His Gln Ala Gly Tyr Ala Asn Ala Ala Asp  
20 25 30

Arg Glu Ser Gly Ile Pro Ala Ala Val Leu Asp Gly Ile Lys Ala Val  
35 40 45

Ala Lys Glu Lys Asn Ala Thr Leu Met Phe Arg Leu Val Asn Pro His  
50 55 60

Ser Thr Ser Leu Ile Ala Glu Gly Val Ala Thr Lys Gly Leu Gly Val  
65 70 75 80

His Ala Lys Ser Ser Asp Trp Gly Leu Gln Ala Gly Tyr Ile Pro Val  
85 90 95

Asn Pro Asn Leu Ser Lys Leu Phe Gly Arg Ala Pro Glu Val Ile Ala  
100 105 110

Arg Ala Asp Asn Asp Val Asn Ser Ser Leu Ala His Gly His Thr Ala  
115 120 125

Val Asp Leu Thr Leu Ser Lys Glu Arg Leu Asp Tyr Leu Arg Gln Ala  
130 135 140

Gly Leu Val Thr Gly Met Ala Asp Gly Val Val Ala Ser Asn His Ala  
145 150 155 160

Gly Tyr Glu Gln Phe Glu Phe Arg Val Lys Glu Thr Ser Asp Gly Arg  
165 170 175

Tyr Ala Val Gln Tyr Arg Arg Lys Gly Gly Asp Asp Phe Glu Ala Val  
180 185 190

Lys Val Ile Gly Asn Ala Ala Gly Ile Pro Leu Thr Ala Asp Ile Asp  
195 200 205

Met Phe Ala Ile Met Pro His Leu Ser Asn Phe Arg Asp Ser Ala Arg  
210 215 220

Ser Ser Val Thr Ser Gly Asp Ser Val Thr Asp Tyr Leu Ala Arg Thr  
225 230 235 240

Arg Arg Ala Ala Ser Glu Ala Thr Gly Gly Leu Asp Arg Glu Arg Ile  
245 250 255

Asp Leu Leu Trp Lys Ile Ala Arg Ala Gly Ala Arg Ser Ala Val Gly  
260 265 270

Thr Glu Ala Arg Arg Gln Phe Arg Tyr Asp Gly Asp Met Asn Ile Gly  
 275 280 285

Val Ile Thr Asp Phe Glu Leu Glu Val Arg Asn Ala Leu Asn Arg Arg  
 290 295 300

Ala His Ala Val Gly Ala Gln Asp Val Val Gln His Gly Thr Glu Gln  
 305 310 315 320

Asn Asn Pro Phe Pro Glu Ala Asp Glu Lys Ile Phe Val Val Ser Ala  
 325 330 335

Thr Gly Glu Ser Gln Met Leu Thr Arg Gly Gln Leu Lys Glu Tyr Ile  
 340 345 350

Gly Gln Gln Arg Gly Glu Gly Tyr Val Phe Tyr Glu Asn Arg Ala Tyr  
 355 360 365

Gly Val Ala Gly Lys Ser Leu Phe Asp Asp Gly Leu Gly Ala Ala Pro  
 370 375 380

Gly Val Pro Ser Gly Arg Ser Lys Phe Ser Pro Asp Val Leu Glu Thr  
 385 390 395 400

Val Pro Ala Ser Pro Gly Leu Arg Arg Pro Ser Leu Gly Ala Val Glu  
 405 410 415

Arg Gln Asp Ser Gly Tyr Asp Ser Leu Asp Gly Val Gly Ser Arg Ser  
 420 425 430

Phe Ser Leu Gly Glu Val Ser Asp Met Ala Ala Val Glu Ala Ala Glu  
 435 440 445

Leu Glu Met Thr Arg Gln Val Leu His Ala Gly Ala Arg Gln Asp Asp  
 450 455 460

Ala Glu Pro Gly Val Ser Gly Ala Ser Ala His Trp Gly Gln Arg Ala  
 465 470 475 480

Leu Gln Gly Ala Gln Ala Val Ala Ala Ala Gln Arg Leu Val His Ala  
 485 490 495

Ile Ala Leu Met Thr Gln Phe Gly Arg Ala Gly Ser Thr Asn Thr Pro  
 500 505 510

Gln Glu Ala Ala Ser Leu Ser Ala Ala Val Phe Gly Leu Gly Glu Ala  
 515 520 525

Ser Ser Ala Val Ala Glu Thr Val Ser Gly Phe Phe Arg Gly Ser Ser  
530 535 540

Arg Trp Ala Gly Gly Phe Gly Val Ala Gly Gly Ala Met Ala Leu Gly  
545 550 555 560

Gly Gly Ile Ala Ala Ala Val Gly Ala Gly Met Ser Leu Thr Asp Asp  
565 570 575

Ala Pro Ala Gly Gln Lys Ala Ala Ala Gly Ala Glu Ile Ala Leu Gln  
580 585 590

Leu Thr Gly Gly Thr Val Glu Leu Ala Ser Ser Ile Ala Leu Ala Leu  
595 600 605

Ala Ala Ala Arg Gly Val Thr Ser Gly Leu Gln Val Ala Gly Ala Ser  
610 615 620

Ala Gly Ala Ala Ala Gly Ala Leu Ala Ala Ala Leu Ser Pro Met Glu  
625 630 635 640

Ile Tyr Gly Leu Val Gln Gln Ser His Tyr Ala Asp Gln Leu Asp Lys  
645 650 655

Leu Ala Gln Glu Ser Ser Ala Tyr Gly Tyr Glu Gly Asp Ala Leu Leu  
660 665 670

Ala Gln Leu Tyr Arg Asp Lys Thr Ala Ala Glu Gly Ala Val Ala Gly  
675 680 685

Val Ser Ala Val Leu Ser Thr Val Gly Ala Ala Val Ser Ile Ala Ala  
690 695 700

Ala Ala Ser Val Val Gly Ala Pro Val Ala Val Val Thr Ser Leu Leu  
705 710 715 720

Thr Gly Ala Leu Asn Gly Ile Leu Arg Gly Val Gln Gln Pro Ile Ile  
725 730 735

Glu Lys Leu Ala Asn Asp Tyr Ala Arg Lys Ile Asp Glu Leu Gly Gly  
740 745 750

Pro Gln Ala Tyr Phe Glu Lys Asn Leu Gln Ala Arg His Glu Gln Leu  
755 760 765

Ala Asn Ser Asp Gly Leu Arg Lys Met Leu Ala Asp Leu Gln Ala Gly  
770 775 780

Trp Asn Ala Ser Ser Val Ile Gly Val Gln Thr Thr Glu Ile Ser Lys  
785 790 795 800

Ser Ala Leu Glu Leu Ala Ala Ile Thr Gly Asn Ala Asp Asn Leu Lys  
805 810 815

Ser Val Asp Val Phe Val Asp Arg Phe Val Gln Gly Glu Arg Val Ala  
820 825 830

Gly Gln Pro Val Val Leu Asp Val Ala Ala Gly Gly Ile Asp Ile Ala  
835 840 845

Ser Arg Lys Gly Glu Arg Pro Ala Leu Thr Phe Ile Thr Pro Leu Ala  
850 855 860

Ala Pro Gly Glu Glu Gln Arg Arg Arg Thr Lys Thr Gly Lys Ser Glu  
865 870 875 880

Phe Thr Thr Phe Val Glu Ile Val Gly Lys Gln Asp Arg Trp Arg Ile  
885 890 895

Arg Asp Gly Ala Ala Asp Thr Thr Ile Asp Leu Ala Lys Val Val Ser  
900 905 910

Gln Leu Val Asp Ala Asn Gly Val Leu Lys His Ser Ile Lys Leu Asp  
915 920 925

Val Ile Gly Gly Asp Gly Asp Asp Val Val Leu Ala Asn Ala Ser Arg  
930 935 940

Ile His Tyr Asp Gly Gly Ala Gly Thr Asn Thr Val Ser Tyr Ala Ala  
945 950 955 960

Leu Gly Arg Gln Asp Ser Ile Thr Val Ser Ala Asp Gly Glu Arg Phe  
965 970 975

Asn Val Arg Lys Gln Leu Asn Asn Ala Asn Val Tyr Arg Glu Gly Val  
980 985 990

Ala Thr Gln Thr Thr Ala Tyr Gly Lys Arg Thr Glu Asn Val Gln Tyr  
995 1000 1005

Arg His Val Glu Leu Ala Arg Val Gly Gln Val Val Glu Val Asp  
1010 1015 1020

Thr Leu Glu His Val Gln His Ile Ile Gly Gly Ala Gly Asn Asp  
1025 1030 1035

Ser Ile Thr Gly Asn Ala His Asp Asn Phe Leu Ala Gly Gly Ser  
1040 1045 1050

Gly Asp Asp Arg Leu Asp Gly Gly Ala Gly Asn Asp Thr Leu Val  
 1055 1060 1065  
 Gly Gly Glu Gly Gln Asn Thr Val Ile Gly Gly Ala Gly Asp Asp  
 1070 1075 1080  
 Val Phe Leu Gln Asp Leu Gly Val Trp Ser Asn Gln Leu Asp Gly  
 1085 1090 1095  
 Gly Ala Gly Val Asp Thr Val Lys Tyr Asn Val His Gln Pro Ser  
 1100 1105 1110  
 Glu Glu Arg Leu Glu Arg Met Gly Asp Thr Gly Ile His Ala Asp  
 1115 1120 1125  
 Leu Gln Lys Gly Thr Val Glu Lys Trp Pro Ala Leu Asn Leu Phe  
 1130 1135 1140  
 Ser Val Asp His Val Lys Asn Ile Glu Asn Leu His Gly Ser Arg  
 1145 1150 1155  
 Leu Asn Asp Arg Ile Ala Gly Asp Asp Gln Asp Asn Glu Leu Trp  
 1160 1165 1170  
 Gly His Asp Gly Asn Asp Thr Ile Arg Gly Arg Gly Gly Asp Asp  
 1175 1180 1185  
 Ile Leu Arg Gly Gly Leu Gly Leu Asp Thr Leu Tyr Gly Glu Asp  
 1190 1195 1200  
 Gly Asn Asp Ile Phe Leu Gln Asp Asp Glu Thr Val Ser Asp Asp  
 1205 1210 1215  
 Ile Asp Gly Gly Ala Gly Leu Asp Thr Val Asp Tyr Ser Ala Met  
 1220 1225 1230  
 Ile His Pro Gly Arg Ile Val Ala Pro His Glu Tyr Gly Phe Gly  
 1235 1240 1245  
 Ile Glu Ala Asp Leu Ser Arg Glu Trp Val Arg Lys Ala Ser Ala  
 1250 1255 1260  
 Leu Gly Val Asp Tyr Tyr Asp Asn Val Arg Asn Val Glu Asn Val  
 1265 1270 1275  
 Ile Gly Thr Ser Met Lys Asp Val Leu Ile Gly Asp Ala Gln Ala  
 1280 1285 1290  
 Asn Thr Leu Met Gly Gln Gly Gly Asp Asp Thr Val Arg Gly Gly  
 1295 1300 1305

Asp Gly Asp Asp Leu Leu Phe Gly Gly Asp Gly Asn Asp Met Leu  
1310 1315 1320

Tyr Gly Asp Ala Gly Asn Asp Thr Leu Tyr Gly Gly Leu Gly Asp  
1325 1330 1335

Asp Thr Leu Glu Gly Gly Ala Gly Asn Asp Trp Phe Gly Gln Thr  
1340 1345 1350

Gln Ala Arg Glu His Asp Val Leu Arg Gly Gly Asp Gly Val Asp  
1355 1360 1365

Thr Val Asp Tyr Ser Gln Thr Gly Ala His Ala Gly Ile Ala Ala  
1370 1375 1380

Gly Arg Ile Gly Leu Gly Ile Leu Ala Asp Leu Gly Ala Gly Arg  
1385 1390 1395

Val Asp Lys Leu Gly Glu Ala Gly Ser Ser Ala Tyr Asp Thr Val  
1400 1405 1410

Ser Gly Ile Glu Asn Val Val Gly Thr Glu Leu Ala Asp Arg Ile  
1415 1420 1425

Thr Gly Asp Ala Gln Ala Asn Val Leu Arg Gly Ala Gly Gly Ala  
1430 1435 1440

Asp Val Leu Ala Gly Gly Glu Gly Asp Asp Val Leu Leu Gly Gly  
1445 1450 1455

Asp Gly Asp Asp Gln Leu Ser Gly Asp Ala Gly Arg Asp Arg Leu  
1460 1465 1470

Tyr Gly Glu Ala Gly Asp Asp Trp Phe Phe Gln Asp Ala Ala Asn  
1475 1480 1485

Ala Gly Asn Leu Leu Asp Gly Gly Asp Gly Arg Asp Thr Val Asp  
1490 1495 1500

Phe Ser Gly Pro Gly Arg Gly Leu Asp Ala Gly Ala Lys Gly Val  
1505 1510 1515

Phe Leu Ser Leu Gly Lys Gly Phe Ala Ser Leu Met Asp Glu Pro  
1520 1525 1530

Glu Thr Ser Asn Val Leu Arg Asn Ile Glu Asn Ala Val Gly Ser  
1535 1540 1545

Ala Arg Asp Asp Val Leu Ile Gly Asp Ala Gly Ala Asn Val Leu  
1550 1555 1560

Asn Gly Leu Ala Gly Asn Asp Val Leu Ser Gly Gly Ala Gly Asp  
1565 1570 1575

Asp Val Leu Leu Gly Asp Glu Gly Ser Asp Leu Leu Ser Gly Asp  
1580 1585 1590

Ala Gly Asn Asp Asp Leu Phe Gly Gly Gln Gly Asp Asp Thr Tyr  
1595 1600 1605

Leu Phe Gly Val Gly Tyr Gly His Asp Thr Ile Tyr Glu Ser Gly  
1610 1615 1620

Gly Gly His Asp Thr Ile Arg Ile Asn Ala Gly Ala Asp Gln Leu  
1625 1630 1635

Trp Phe Ala Arg Gln Gly Asn Asp Leu Glu Ile Arg Ile Leu Gly  
1640 1645 1650

Thr Asp Asp Ala Leu Thr Val His Asp Trp Tyr Arg Asp Ala Asp  
1655 1660 1665

His Arg Val Glu Ile Ile His Ala Ala Asn Gln Ala Val Asp Gln  
1670 1675 1680

Ala Gly Ile Glu Lys Leu Val Glu Ala Met Ala Gln Tyr Pro Asp  
1685 1690 1695

Pro Gly Ala Ala Ala Ala Ala Pro Pro Ala Ala Arg Val Pro Asp  
1700 1705 1710

Thr Leu Met Gln Ser Leu Ala Val Asn Trp Arg  
1715 1720

<210> 5

<211> 9905

<212> DNA

<213> Bordetella pertussis - NA-CyaA pJR1 plasmid DNA

<400> 5

ctcgagaaat cataaaaaat ttatttgctt tgtgagcgga taacaattat aatagattca  
60

attgtgagcg gataacaatt tcacacagaa ttcattaaag aggagaaatt aactatgaga  
120

ggatcgcatc accatcacca tcacggatcc gcatgcgagc tcggtaccat gcagcaatcg  
180

catcaggctg gttacgcaaa cgccgccgac cgggagtctg gcatccccgc agccgtactc  
240

gatggcatca aggccgtggc gaaggaaaaa aacgccacat tgatgttccg cctgggtcaac  
300

ccccattcca ccagcctgat tgccgaagggt gtggccacca aaggattggg cgtgcacgcc  
360

aagtcgtccg attgggggtt gcaggcgggc tacattcccg tcaacccgaa tttttccaaa  
420

ctgttcggcc gtgcgcccga ggtgatcgcg cgggcccaca acgacgtcaa cagcagcctg  
480

gcgcatggcc ataccgcggt cgacctgacg ctgtcgaaaag agcggcttga ctatctgcgg  
540

caagcgggcc tggtcaccgg catggccgat ggctgtgtcg cgagcaacca cgcaggctac  
600

gagcagttcg agtttcgcgt gaaggaaacc tcggacgggc gctatgccgt gcagtatcgc  
660

cgcaagggcg gcgacgattt cgaggcggtc aaggatgatcg gcaatgccgc cggatttcca  
720

ctgacggcgg atatcgacat gttcgccatt atgccgcac tgtccaactt ccgcgactcg  
780

gcgcgcagtt cgggtgaccag cggcgattcg gtgaccgatt acctggcgcg cacgcggcgg  
840

gccgccagcg aggccacggg cggcctggat cgcgaacgca tcgacttggt gtggaaaatc  
900

gctcgcgccg gcgcccgttc cgcagtgggc accgaggcgc gtcgccagtt ccgctacgac  
960

ggcgacatga atacggcgt gatcaccgat ttcgagctgg aagtgcgcaa tgcgctgaac  
1020

aggcggggcg acgccgtcgg cgcgcaggac gtggtccagc atggcactga gcagaacaat  
1080

cctttcccgg aggcagatga gaagattttc gtcgtatcgg ccaccggtga aagccagatg  
1140

ctcacgcgcg ggcaactgaa ggaatacatt ggccagcagc gcggcgaggg ctatgtcttc  
1200

tacgagaacc gtgcatacgg cgtggcgggg aaaagcctgt tcgacgatgg gctgggagcc  
1260

gcgcccggcg tgccgagcgg acgttcgaag ttctcgccgg atgtactgga aacgggtgccg  
1320

gcgtcaccgg gattgcggcg gccgtcgctg ggcgagtggt aacgccagga ttccggctat  
1380

gacagccttg atgggggtgg atcgcgatcg ttctcgttgg gcgaggtgtc cgacatggcc  
1440

gccgtggaag cggcggaact ggaaatgacc cggcaagtct tgcacgccgg ggcgcggcag  
1500

gacgatgccg agccgggctg gagcgggtcg tcggcgactt gggggcagcg ggcgctgacg  
1560



ggcgcccagg cgggtggcggc ggcgagcgg ctggttcatg ccattgccct gatgacgcaa  
1620

ttcggccggg ccggttccac caacacgccg caggaagcgg cctcgttgtc ggcgccgtg  
1680

ttcggcttg gcgaggccag cagcgccgtg gccgaaaccg tgagcggtt tttccgagg  
1740

tcttcgcgt ggccggcgg tttcggcgtg gctggcggc cgatggcgt gggaggcggc  
1800

atcgccggc ccgttggcgc cgggatgtcg ttgaccgat acgcgccggc cggacagaag  
1860

gccgccggc gcgccgagat cgcgctgcag ttgacaggc gaacggcga gctggcttct  
1920

tccatcgct tggcgtggc cgcggcgcgc ggcgtgacca gggcttgca ggtggccggg  
1980

gcgtcgccg ggccggcgtc cggcgattg gcccgggcgc tcagtcccat ggagatctac  
2040

ggcctggtg agcaatcgca ctatgggat cagctggaca agctggcga ggaatcgagc  
2100

gcatacggtt acgagggcga cgccttgctg gccagctgt atcgcgacaa gacggccgcc  
2160

gagggcgccg tcgccggcgt ctccgccgtc ctgagcacgg tggggggcggc ggtgtcgatc  
2220

gcccgggcg ccagcgtggt agggggcccc gtggcgggtg tcaattcctt gctgaccggg  
2280

gctctcaacg gcatcctgcg cggcgtgcag cagcccatca tcgaaaagct ggccaacgat  
2340

tacgctcgca agatcgacga gctggcgagg ccgcaagcgt acttcgagaa aaacctgcag  
2400

gcgcgtcacg aacaactggc caattcggac ggcctacgga aatgctggc cgacctgcag  
2460

gccggttga acgccagcag cgtgatcggg gtgcagacga cagagatctc caagtcggcg  
2520

ctcgaactgg ccgccattac cggcaacgcg gacaacctga aatccgtcga cgtgttcgtg  
2580

gaccgcttcg tccagggcga gcgggtggcc ggccagccgg tggctctcga cgtcgccgcc  
2640

ggcgcatcg atatcgccag ccgcaaggc gagcggccgg cgctgacgtt catcacgccg  
2700

ctggccgcgc caggagaaga gcagcgccgg cgcacgaaaa cgggcaagag cgaattcacc  
2760

acattcgtcg agatcgtggg caagcaggac cgctggcgca tccgggacgg cgcggccgac  
2820

accaccatcg atctggccaa ggtggtgtcg caactggcgt acgccaatgg cgtgctcaag  
2880

cacagcatca aactggatgt gatcggcgga gatggcgatg acgtcgtgct tgccaatgct  
2940

tcgcgcatcc attatgacgg cggcgcgggc accaacacgg tcagctatgc cgccctgggt  
3000

cgacaggatt ccattaccgt gtccgccgac ggggaacgtt tcaacgtgcg caagcagttg  
3060

aacaacgcca acgtgtatcg cgaaggcgtg gctaccaga caaccgccta cggcaagcgc  
3120

acggagaatg tccaataaccg ccatgtcgag ctggcccgtg tcgggcaagt ggtggaggtc  
3180

gacacgctcg agcatgtgca gcacatcatc ggcggggccc gcaacgattc gatcaccggc  
3240

aatgcgcacg acaacttcct agccggcggg tcgggcgacg acaggctgga tggcgggcgc  
3300

ggcaacgaca ccctggttgg cggcgagggc caaacacgg tcatcggcg cgccggcgac  
3360

gacgtattcc tgcaggacct gggggtatgg agcaaccagc tcgatggcgg cgcgggcgct  
3420

gataccgtga agtacaacgt gcaccagcct tccgaggagc gcctcgaacg catgggcgac  
3480

acgggcatcc atgccgatct taaaagggc acggtcgaga agtggccggc cctgaacctg  
3540

ttcagcgtcg accatgtcaa gaatatcgag aatctgcacg gctccgcct aaacgaccgc  
3600

atcgccggcg acgaccagga caacgagctc tggggccacg atggcaacga cacgatacgc  
3660

ggccggggcg gcgacgacat cctgcgcggc ggccctgggccc tggacacgct gtatggcgag  
3720

gacggcaacg acatcttcct gcaggacgac gagaaccgtca gcgatgacat cgacggcggc  
3780

gcggggctgg acaccgtcga ctactccgcc atgatccatc caggcaggat cgttgcgccc  
3840

catgaatacg gcttcgggat cgaggcggac ctgtccaggg aatgggtgcg caaggcgtcc  
3900

gcgctgggcy tggactatta cgataatgtc cgcaatgtcg aaaacgtcat cggtacgagc  
3960

atgaaggatg tgctcatcgg cgacgcgcaa gccaatacc tgatgggcca gggcggcgac  
4020

gataccgtgc gcggcggcga cggcgatgat ctgctgttcg gcggcgacgg caacgacatg  
4080

ctgtatggcg acgccggcaa cgacaccctc tacggggggc tggcgacga tacccttgaa  
4140

ggcgcgcgcg gcaacgattg gtccggccag acgcaggcgc gcgagcatga cgtgctgcgc  
4200

ggcggagatg ggggtggatac cgtcgattac agccagaccg gcgcgcatgc cggcattgcc  
4260

gcgggtcgca tcgggctggg catcctggct gacctgggcg ccggccgcgt cgacaagctg  
4320

ggcgaggccg gcagcagcgc ctacgatacg gtttccggta tcgagaacgt ggtgggcacg  
4380

gaactggccg accgcatac gggcgatgcg caggccaacg tgctgcgcgg cgcgggtggc  
4440

gccgacgtgc ttgcgggcgg cgagggcgac gatgtgctgc tgggcggcga cggcgacgac  
4500

cagctgtcgg gcgacgccg acgcgatcgc ttgtacggc aagccggtga cgactggttc  
4560

ttccaggatg ccgccaatgc cggcaatctg ctcgacggcg gcgacggccg cgataccgtg  
4620

gatttcagcg gcccgggccg gggcctcgac gccggcgcaa agggcgatt cctgagcttg  
4680

ggcaaggggt tcgccagcct gatggacgaa cccgaaacca gcaacgtgtt gcgcaatata  
4740

gagaacgccg tgggcagcgc gcgtgatgac gtgctgatcg gcgacgcagg cgccaacgtc  
4800

ctcaatggcc tggcgggcaa cgacgtgctg tccggcgcg ctggcgacga tgtgctgctg  
4860

ggcgacgagg gctcggacct gctcagcggc gatgcgggca acgacgatct gttcggcggg  
4920

cagggcgatg ataattatct gttcggggtc gggtagggc acgacacgat ctacgaatcg  
4980

ggcgcgggcc atgacaccat ccgcatcaac gcggggcgcg accagctgtg gttcgcgcgc  
5040

cagggcaacg acctggagat ccgcattctc ggcaccgacg atgcacttac cgtgcacgac  
5100

tggtatcgcg acgccgatca ccgggtggaa atcatccatg ccgccaacca ggcggtagac  
5160

caggcaggca tcgaaaagct ggtcgaggca atggcgagc atccggaccc cggcgcgcg  
5220

gcggctgccc cgcggcggc gcgcgtgccg gacacgtga tcagtcctt ggctgtcaac  
5280

tggcgctgag gatccctcga ggtcgacctg cagggggacc atggtctctg atatctaact  
5340

aagcttaatt agctgagctt ggactcctgt tgatagatcc agtaatgacc tcagaactcc  
5400

atctggattt gttcagaacg ctcggttgcc gccgggcgtt ttttattggt gagaatccaa  
5460

gctagcttg cagattttc aggagctaag gaagctaaaa tggagaaaa aatcactgga  
5520

tataccaccg ttgatatac ccaatggcat cgtaaagaac attttgaggc atttcagtca  
5580

gttgctcaat gtacctataa ccagaccgtt cagctggata ttacggcctt tttaaagacc  
5640

gtaaagaaaa ataagcacia gttttatccg gcctttattc acattcttgc ccgcctgatg  
5700

aatgctcatc cggaatttgc tatggcaatg aaagacggtg agctggtgat atgggatagt  
5760

gttcaccctt gttacaccgt tttccatgag caaactgaaa cgttttcatc gctctggagt  
5820

gaataccacg acgatttccg gcagtttcta cacatatatt cgcaagatgt ggcgtgttac  
5880

ggtgaaaacc tggcctatct ccctaaaggg tttattgaga atatgttttt cgtctcagcc  
5940

aatccctggg tgagtttca cagttttgat ttaaactgtg ccaatatgga caacttcttc  
6000

gccccgctt tcaccatggg caaatattat acgcaaggcg acaagggtgt gatgccgctg  
6060

gcgattcagg ttcacatgc cgtttgtgat ggcttccatg tcggcagaat gcttaatgaa  
6120

ttacaacagt actgcgatga gtggcagggc ggggcgtaat tttttaagg cagttattgg  
6180

tgcccttaaa cgctgggggt aatgactctc tagcttgagg catcaaataa aacgaaaggc  
6240

tcagtcgaaa gactgggcct ttcgttttat ctgttgtttg tcggtgaacg ctctcctgag  
6300

taggacaaat ccgccctcta gattacgtgc agtcgatgat aagctgtcaa acatgagaat  
6360

tgtgcctaata gactgagcta acttacatta attgcgttgc gctcactgcc cgctttccag  
6420

tcgggaaacc tgtcgtgcc gctgcattaa tgaatcgcc aacgcgcggg gagaggcggg  
6480

ttgcgtattg ggcgccaggg tggtttttct tttcaccagt gagacgggca acagctgatt  
6540

gcccttcacc gcctggccct gagagagttg cagcaagcgg tcacgctgg tttgccccag  
6600

caggcgaata tctgtttga tgggtggttaa cggcgggata taacatgagc tgtcttcggt  
6660

atcgtcgtat cccactaccg agatatccgc accaacgcgc agcccggact cggtaatggc  
6720

gcgcattgcg ccacgcgcca tctgatcgtt ggcaaccagc atcgcagtgg gaacgatgcc  
6780

ctcattcagc atttgcatgg tttgttgaaa accggacatg gcactccagt cgccttcccc  
6840

ttccgctatc ggctgaattt gattgcgagt gagatattha tgccagccag ccagacgcag  
6900

acgcgccgag acagaactta atgggccgcg taacagcgcg atttgctggt gaccaaatgc  
6960

gaccagatgc tccacgcca gtcggtacc gtcttcattg gagaaaataa tactgttgat  
7020

gggtgtctgg tcagagacat caagaaataa cgccggaaca ttagtgagg cagcttcac  
7080

agcaatggca tctgtgcat ccagcgata gttaatgatg agccactga cgcgttgcg  
7140

gagaagattg tgcaccgccc ctttacaggc ttcgacgccc cttcgttcta ccatcgacac  
7200

caccacgctg gcaccagtt gatcggcgcg agatttaatc gccgcgaca tttgcgagg  
7260

cgcgtgagg gccagactgg aggtggcaac gccaatcagc aacgactgtt tgcccgccag  
7320

ttgttgagg acgcggttg gaatgtaatt cagctccgccc atcgcgctt ccacttttc  
7380

ccgcgttttc gcagaaacgt ggctggcctg gttcaccacg cgggaaacgg tctgataaga  
7440

gacaccggca tactctgca catcgataaa cgttactggt ttcacattca ccaccctgaa  
7500

ttgactctct tccgggcgct atcatgcca accgcgaaag gttttgcacc attcgatggt  
7560

gtcgggaattt cgggcagcgt tgggtcctgg ccacgggtgc gcatgatcta gagctgcctc  
7620

gcgcgtttcg gtgatgagg tgaaaacctc tgacacatgc agctcccga gacggtcaca  
7680

gcttgctgt aagcgatgc cgggagcaga caagccgctc agggcgctc agcgggtgtt  
7740

ggcgggtgct ggggcgcagc catgaccag tcacgtaggc atagcggagt gtatactggc  
7800

ttaactatgc ggcatcagag cagattgtac tgagagtga ccatatgcgg tgtgaaatac  
7860

cgacagatg cgtaaggaga aaataccgca tcaggcgctc ttccgcttc tcgctcactg  
7920

actcgctgcg ctcggtcgtt cggctgcggc gagcggatc agctcactca aaggcggtaa  
7980

tacggttatc cacagaatca ggggataacg caggaaagaa catgtgagca aaaggccagc  
8040

aaaaggccag gaaccgtaaa aaggccgctg tgctggcgtt tttccatagg ctccgcccc  
8100

ctgacgagca tcacaaaaat cgacgtcaa gtcagagggt gcgaaaccgc acaggactat  
8160

aaagatacca ggcgtttccc cctggaagct ccctcgtgcg ctctcctggt ccgaccctgc  
8220

cgcttaccgg atacctgtcc gcctttctcc cttcggaag cgtggcgctt tctcatagct  
8280

cacgctgtag gtatctcagt tcggtgtagg tcgttcgctc caagctgggc tgtgtgcacg  
8340

aacccccgt tcagcccgac cgctgcgcct tatccggtaa ctatcgtctt gagtccaacc  
8400

cggtaaagaca cgacttatcg ccactggcag cagccactgg taacaggatt agcagagcga  
8460

ggtatgtagg cgggtctaca gagttcttga agtggtggcc taactacggc tacactagaa  
8520

ggacagtatt tggatatctgc gctctgctga agccagttac cttcggaata agagttggta  
8580

gctcttgatc cggcaataca accaccgctg gtagcggtag ttttttgggt tgcaagcagc  
8640

agattacgag cagaaaaaaaa ggatctcaag aagatccttt gatcttttct acgggggtctg  
8700

acgctcagtg gaacgaaaac tcacgttaag ggattttgggt catgagatta tcaaaaagga  
8760

tcttcaccta gatcctttta aattaaaaat gaagttttta atcaatctaa agtatatatg  
8820

agtaaacttg gtctgacagt taccaatgct taatcagtga ggcacctatc tcagcgatct  
8880

gtctatttcg ttcattcata gttgcctgac tccccgctgt gtagataact acgatacggg  
8940

agggcttacc atctggcccc agtgctgcaa tgataccgag agaccacgc tcaccggctc  
9000

cagatttatc agcaataaac cagccagccg gaagggccga gcgcagaagt ggtcctgcaa  
9060

ctttatccgc ctccatccag tctattaatt gttgccggga agctagagta agtagttcgc  
9120

cagttaatag tttgcgcaac gttgttgcca ttgctacagg catcgtgggt tcacgctcgt  
9180

cgtttggtat ggcttcattc agctccgggt cccaacgata aaggcgagtt acatgatccc  
9240

ccatgttgtg caaaaaagcg gttagctcct tcggctcctc gatcgttgct agaagtaagt  
9300

tggccgcagt gttatcactc atgggtatgg cagcactgca taattctctt actgtcatgc  
9360

catccgtaag atgcttttct gtgactgggt agtactcaac caagtcattc tgagaatagt  
9420

gtatgcggcg accgagttgc tcttgcccg cgtaatacg ggataatacc gcgccacata  
9480

gcagaacttt aaaagtgtc atcattggaa aacgttcttc ggggcgaaaa ctctcaagga  
9540

tcttaccgct gttgagatcc agttcgatgt aaccactcg tgcaccaaac tgatcttcag  
9600

catcttttac tttcaccagc gtttctgggt gagcaaaaac aggaaggcaa aatgccgcaa  
9660

aaaagggaat aaggcgaca cggaaatgtt gaatactcat actcttcctt tttcaatatt  
9720

attgaagcat ttatcagggt tattgtctca tgagcggata catatttgaa tgtatttaga  
9780

aaaataaaca aataggggtt ccgcgcacat ttccccgaaa agtgccacct gacgtctaag  
9840

aaaccattat tatcatgaca ttaacctata aaaataggcg tatcacgagg ccctttcgct  
9900

ttcac  
9905

<210> 6  
<211> 9905  
<212> DNA  
<213> Bordetella pertussis - NA-iAC-CyaA APB22

<400> 6  
ctcgagaaat cataaaaaat ttatttgctt tgtgagcgga taacaattat aatagattca  
60

attgtgagcg gataacaatt tcacacagaa ttcattaaag aggagaaatt aactatgaga  
120

ggatcgcatc accatcacca tcacggatcc gcatgcgagc tcggtacat gcagcaatcg  
180

catcaggctg gttacgcaa cgcgcgcgac cgggagtctg gcatccccgc agccgtactc  
240

gatggcatca aggccgtggc gaaggaaaa aacgccacat tgatgttccg cctgggtcaac  
300

ccccattcca ccagcctgat tgccgaagg gtggccacca aaggattggg cgtggccgcc  
360

gcgggatccg attgggggtt gcaggcgggc tacattcccg tcaaccgaa tctttccaaa  
420

ctgttcggcc gtgcgcccga ggtgatcgcg cgggcccaca acgacgtcaa cagcagcctg  
480

gcgcatggcc ataccgcggt cgacctgacg ctgtcgaaag agcggcttga ctatctgcgg  
540

caagcgggccc tggtcaccgg catggccgat ggcgtggtcg cgagcaacca cgcaggctac  
600

gagcagttcg agtttcgct gaaggaaacc tcggacgggc gctatgccgt gcagtatcg  
660

cgcaaggcg gcgacgattt cgaggcggtc aaggatgatc gcaatgccgc cggatttcca  
720

ctgacggcgg atatcgacat gttcgccatt atgccgcatt tgtccaactt ccgcgactcg  
780

gcgcgcagtt cggtgaccag cggcgattcg gtgaccgatt acctggcgcg cacgcggcgg  
840

gccgccagcg aggccacggg cggcctggat cgcgaacgca tcgacttggt gtggaaaatc  
900

gctcgcgcgg gcgcccgttc cgcagtgggc accgaggcgc gtcgccagtt ccgctacgac  
960

ggcgacatga atatcggcgt gatcacgat ttcgagctgg aagtgcgcaa tgcgctgaac  
1020

aggcggggcg acgcgctcgg cgcgcaggac gtggtccagc atggcactga gcagaacaat  
1080

cctttcccgg aggcagatga gaagattttc gtcgtatcgg ccaccgggtga aagccagatg  
1140

ctcacgcgcg ggcaactgaa ggaatacatt ggccagcagc gcggcgaggg ctatgtcttc  
1200

tacgagaacc gtgcatacgg cgtggcgggg aaaagcctgt tcgacgatgg gctgggagcc  
1260

gcgcccggcg tgccgagcgg acgttcgaag ttctcgccgg atgtactgga aacggtgccg  
1320

gcgtcaccgg gattgcggcg gccgtcgtg ggcgagtggt aacgccagga ttccggctat  
1380

gacagccttg atgggggtgg atcgcgatcg ttctcgttgg gcgaggtgtc cgacatggcc  
1440

gccgtggaag cggcggaact ggaaatgacc cggcaagtct tgcacgccgg gcgcggcgag  
1500

gacgatgccg agccgggctg gagcgtgctg tcggcgcaact gggggcagcg ggcgctgcag  
1560

ggcggccagg cggtggcggc ggcgcagcgg ctggttcatt ccattgccct gatgacgcaa  
1620

ttcggccggg ccggttccac caacacgccg caggaagcgg cctcgttgtc ggcggccgtg  
1680

ttcggcttgg gcgaggccag cagcgccgtg gccgaaaccg tgagcggttt ttcccgcggg  
1740

tcttcgcgct gggccggcgg ttccggcgtg gctggcggcg cgatggcgct gggaggcggc  
1800

atcgccgcgg ccgttggcgc cgggatgtcg ttgaccgatg acgcgccggc cggacagaag  
1860

gccgccgcgg gcgccgagat cgcgctgcag ttgacaggtg gaacggtcga gctggcttct  
1920

tccatcgctg tggcgctggc cgcggcgcgc ggcgtgacca gcggcttgca ggtggccggg  
1980

gcgtcggccg gggcggtgc cggcgcatcg gccgcggcgc tcagtcctat ggagatctac  
2040



ggcctggtgc agcaatcgca ctatgcggat cagctggaca agctggcgca ggaatcgagc  
2100

gcatacggtt acgagggcga cgccttgctg gccagctgt atcgcgacaa gacggccgcc  
2160

gagggcgccg tcgccggcgt ctccgccgtc ctgagcacgg tgggggcggc ggtgtcgatc  
2220

gccgcggcgg ccagcgtggt aggggccccg gtggcggtgg tcacttcctt gctgaccggg  
2280

gctctcaacg gcatcctgcg cggcgtgcag cagcccatca tcgaaaagct ggccaacgat  
2340

tacgctcgca agatcgacga gctgggcggg ccgcaagcgt acttcgagaa aaacctgcag  
2400

gcgcgtcacg aacaactggc caattcggac ggcttacgga aaatgctggc cgacctgcag  
2460

gccggttga acgccagcag cgtgatcggg gtgcagacga cagagatctc caagtccggc  
2520

ctcgaactgg ccgccattac cggcaacggg gacaacctga aatccgtcga cgtgttcgtg  
2580

gaccgcttcg tccagggcga gcgggtggcc ggccagccgg tggtcctcga cgtcgccgcc  
2640

ggcggcatcg atatcgccag ccgcaagggc gagcggccgg cgctgacgtt catcacgccg  
2700

ctggccgcgc caggagaaga gcagcggcgg cgcacgaaaa cgggcaagag cgaattcacc  
2760

acattcgtcg agatcgtggg caagcaggac cgtggcgca tccgggacgg cgcggccgac  
2820

accaccatcg atctggccaa ggtggtgtcg caactggtcg acgccaatgg cgtgctcaag  
2880

cacagcatca aactggatgt gatcggcgga gatggcgatg acgtcgtgct tgccaatgct  
2940

tcgcgcattc attatgacgg cggcgcgggc accaacacgg tcagctatgc cgccctgggt  
3000

cgacaggatt ccattaccgt gtccgccgac ggggaacgtt tcaacgtgcg caagcagttg  
3060

aacaacgcca acgtgtatcg cgaaggcgtg gctaccaga caaccgccta cggcaagcgc  
3120

acggagaatg tccaataaccg ccatgtcgag ctggcccgtg tcgggcaagt ggtggaggtc  
3180

gacacgctcg agcatgtgca gcacatcatc ggccggggccg gcaacgattc gatcaccggc  
3240

aatgcgcacg acaacttcct agccggcggg tcgggcgacg acaggctgga tggcggcgcc  
3300

ggcaacgaca ccctggttgg cggcgagggc caaaacacgg tcatcggcgg cgccggcgac  
3360

gacgtatttc tgcaggacct gggggtatgg agcaaccagc tcgatggcgg cgcgggcgtc  
3420

gataccgtga agtacaacgt gcaccagcct tccgaggagc gcctcgaacg catgggagac  
3480

acgggcatcc atgccgatct tcaaaagggc acggctcgaga agtggccggc cctgaacctg  
3540

ttcagcgtcg accatgtcaa gaatatcgag aatctgcacg gctccgcct aaacgaccgc  
3600

atcgccggcg acgaccagga caacgagctc tggggccacg atggcaacga cagatacgc  
3660

ggccggggcg gcgacgacat cctgcgcggc ggccctgggc tggacacgct gtatggcgag  
3720

gacggcaacg acatcttctt gcaggacgac gagaccgtca gcgatgacat cgacggcggc  
3780

gcggggctgg acaccgtcga ctactcgcgc atgatccatc caggcaggat cgttgcgccg  
3840

catgaatacg gcttcgggat cgaggcggac ctgtccaggg aatgggtgcg caaggcgtcc  
3900

gcgctggggc tggactatta cgataatgtc cgcaatgtcg aaaacgtcat cggtagcagc  
3960

atgaaggatg tgctcatcgg cgacgcgcaa gccaatacc tcatgggcca gggcggcgac  
4020

gataccgtgc gcggcggcga cggcgatgat ctgctgttcg gcggcgacgg caacgacatg  
4080

ctgtatggcg acgccggcaa cgacaccctc tacggggggc tgggcgacga tacccttgaa  
4140

ggcggcgcg gcaacgattg gttcggccag acgcaggcgc gcgagcatga cgtgctgcgc  
4200

ggcggagatg ggggtggatac cgtcgattac agccagaccg gcgcgcatgc cggcattgcc  
4260

gcgggtcgca tcgggctggg catcctggct gacctgggcg ccggccgcgt cgacaagctg  
4320

ggcgaggccg gcagcagcgc ctacgatacg gtttcgggta tcgagaacgt ggtgggcacg  
4380

gaactggccg accgcatcac gggcgatgcg caggccaacg tgctgcgcgg cgcgggtggc  
4440

gccgacgtgc ttgcgggcgg cgagggcgac gatgtgctgc tgggcggcga cggcgacgac  
4500

cagctgtcgg gcgacgccgg acgcgatcgc ttgtacggcg aagccgggtga cgactgggtc  
4560

ttccaggatg ccgccaatgc cggcaatctg ctgcacggcg gcgacggccg cgataccgtg  
4620

gatttcagcg gcccgggccg gggcctcgac gccggcgcaa agggcgtatt cctgagcttg  
4680

ggcaaggggt tcgccagcct gatggacgaa cccgaaacca gcaacgtgtt gcgcaatata  
4740

gagaacgccg tgggcagcgc gcgtgatgac gtgctgatcg gcgacgcagg cgccaacgtc  
4800

ctcaatggcc tggcgggcaa cgacgtgctg tccggcggcg ctggcgacga tgtgctgctg  
4860

ggcgacgagg gctcggacct gctcagcggc gatgcgggca acgacgatct gttcggcggg  
4920

caggcgcatg atacttatct gttcggggtc ggttacgggc acgacacgat ctacgaatcg  
4980

ggcggcggcc atgacaccat ccgcatcaac gcgggggcgg accagctgtg gttcgcgcgc  
5040

cagggcaacg acctggagat ccgcattctc ggcaccgacg atgcacttac cgtgcacgac  
5100

tggtatcgcg acgccgatca ccgggtggaa atcatccatg ccgccaacca ggcggtagac  
5160

caggcaggca tcgaaaagct ggtcagggca atggcgcagt atccggaccc cggcgcggcg  
5220

gcggtgccc cgcgcgcgcg gcgcgtgccg gacacgtga tgcagtcctt ggctgtcaac  
5280

tggcgtgag gatccctcga ggtcgacctg cagggggacc atggtctctg atatctaact  
5340

aagcttaatt agctgagctt ggactcctgt tgatagatcc agtaatgacc tcagaactcc  
5400

atctggattt gttcagaacg ctcggttgcc gccgggcgtt ttttattggt gagaatccaa  
5460

gctagcttgg cgagattttc aggagctaag gaagctaaaa tggagaaaaa aatcactgga  
5520

tataccaccg ttgatataac ccaatggcat cgtaaagaac attttgaggc atttcagtca  
5580

gttgctcaat gtacctataa ccagaccgtt cagctggata ttacggcctt tttaaagacc  
5640

gtaaagaaaa ataagcacia gttttatccg gcctttattc acattcttgc ccgcctgatg  
5700

aatgctcatc cggaatttcg tatggcaatg aaagacgggt agctgggtgat atgggatagt  
5760

gttcaccctt gttacaccgt tttccatgag caaactgaaa cgttttcatc gctctggagt  
5820

gaataccacg acgatttccg gcagtttcta cacatatatt cgcaagatgt ggcgtgttac  
5880

ggtgaaaacc tggcctatct ccctaaaggg tttattgaga atatgttttt cgtctcagcc  
5940

aatccctggg tgagtttcac cagttttgat ttaaactggg ccaatatgga caacttcttc  
6000

gcccccgttt tcaccatggg caaatattat acgcaaggcg acaagggtgct gatgccgctg  
6060

gcgattcagg ttcacatcatgc cgtttgtgat ggcttccatg tcggcagaat gcttaatgaa  
6120

ttacaacagt actgcgatga gtggcagggc ggggcgtaat tttttaagg cagttattgg  
6180

tgcccttaaa cgccctgggt aatgactctc tagcttgagg catcaaataa aacgaaaggc  
6240

tcagtcgaaa gactgggcct ttcgttttat ctgttgtttg tcggtgaacg ctctcctgag  
6300

taggacaaat ccgccctcta gattacgtgc agtcgatgat aagctgtcaa acatgagaat  
6360

tgtgcctaata gagtgagcta acttacatta attgcgttgc gctcactgcc cgctttccag  
6420

tcgggaaacc tgcgtgccca gctgcattaa tgaatcgcc aacgcgcggg gagaggcggg  
6480

ttgcgtattg ggcccgaggg tggtttttct tttcaccagt gagacgggca acagctgatt  
6540

gcccttcacc gcctggccct gagagagttg cagcaagcgg tcacgcgtgg ttggccccag  
6600

caggcgaaaa tcctgtttga tgggtggttaa cggcgggata taacatgagc tgtcttcggt  
6660

atcgctgtat cccactaccg agatatccgc accaacgcgc agcccggact cggtaatggc  
6720

gcgcattgcg ccacgcgcca tctgatcgtt ggcaaccagc atcgcagtgg gaacgatgcc  
6780

ctcattcagc atttgcattg tttgttgaac accggacatg gcactccagt cgccttcccg  
6840

ttccgctatc ggctgaattt gattgcgagt gagatattta tgccagccag ccagacgcag  
6900

acgcgcgcag acagaactta atgggcccgc taacagcgcg atttgctggt gacccaatgc  
6960

gaccagatgc tccacgcccc gtcgcgtacc gtcttcatgg gagaaaataa tactgttgat  
7020

gggtgtctgg tcagagacat caagaaataa cgccggaaca ttagtgcagg cagcttccac  
7080

agcaatggca tcctgggtcat ccagcggata gttaatgatc agcccactga cgcgttgccg  
7140

gagaagattg tgcaccgccg ctttacaggc ttcgacgccg cttcgttcta ccatcgacac  
7200

caccacgtg gcaccagtt gatcggcgcg agatttaatc gccgcgacaa tttgcgacgg  
7260

cgctgcagg gccagactgg aggtggcaac gccaatcagc aacgactgtt tgcccgcag  
7320

ttgttggtgcc acgcggttgg gaatgtaatt cagctccgcc atcgccgctt ccactttttc  
7380

ccgcgttttc gcagaaacgt ggctggcctg gttcaccacg cgggaaacgg tctgataaga  
7440

gacaccggca tactctgcga catcgtataa cgttactggg ttcacattca ccaccctgaa  
7500

ttgactctct tccgggcgct atcatgccat accgcgaaag gttttgcacc attcgatggg  
7560

gtcgggaattt cgggcagcgt tgggtcctgg ccacgggtgc gcatgatcta gagctgcctc  
7620

gcgcgtttcg gtgatgacgg tgaaaacctc tgacacatgc agctcccgga gacggtcaca  
7680

gcttgctctgt aagcggatgc cgggagcaga caagcccgtc agggcgcgtc agcgggtgtt  
7740

ggcgggtgtc ggggcgcagc catgaccagc tcacgtagcg atagcggagt gtatactggc  
7800

ttaactatgc ggcatcagag cagattgtac tgagagtgc ccatatgcgg tgtgaaatac  
7860

cgcacagatg cgtaaggaga aaataccgca tcaggcgctc ttccgcttcc tcgctcactg  
7920

actcgctgcg ctcggtcggt cggctgcggc gagcggatc agctcactca aaggcggtaa  
7980

tacggttatc cacagaatca ggggataacg caggaaagaa catgtgagca aaaggccagc  
8040

aaaaggccag gaaccgtaaa aaggccgcgt tgctggcggt tttccatagg ctccgcccc  
8100

ctgacgagca tcacaaaaat cgacgctcaa gtcagagggt gcgaaaccg acaggactat  
8160

aaagatacca ggcgtttccc cctggaagct cctcgtgcg ctctcctgtt ccgaccctgc  
8220

cgcttaccgg atacctgtcc gcctttctcc ctccgggaag cgtggcgctt tctcatagct  
8280

cacgctgtag gtatctcagt tcggtgtagg tcgttcgctc caagctgggc tgtgtgcacg  
8340

aacccccgt tcagcccgac cgctgcgcct tatccggtaa ctatcgtctt gagtccaacc  
8400

cggtaagaca cgacttatcg ccactggcag cagccactgg taacaggatt agcagagcga  
8460

ggtatgtagg cgggtctaca gagttcttga agtggtggcc taactacggc tacactagaa  
8520

ggacagtatt tggatatctgc gctctgtga agccagttac ctccggaaaa agagttggta  
8580

gctcttgatc cggcaaacia accaccgctg gtagcgggtg tttttttgtt tgcaagcagc  
8640

agattacgcg cagaaaaaaa ggatctcaag aagatccttt gatcttttct acgggggtctg  
8700

acgctcagtg gaacgaaaac tcacgttaag ggatttttgt catgagatta tcaaaaagga  
8760

tcttcaccta gatcctttta aattaaaaat gaagttttta atcaatctaa agtatatatg  
8820

agtaaaacttg gtctgacagt taccaatgct taatcagtga ggcacctatc tcagcgatct  
8880

gtctatttgc ttcattccata gttgcctgac tccccgtcgt gtagataact acgatacggg  
8940

agggccttacc atctggcccc agtgctgcaa tgataccgcg agaccacgc tcaccggctc  
9000

cagatttata agcaataaac cagccagccg gaagggccga gcgcagaagt ggtcctgcaa  
9060

ctttatccgc ctccatccag tctattaatt gttgccggga agctagagta agtagttcgc  
9120

cagttaatag tttgcgcaac gttgttgcca ttgctacagg catcgtggtg tcacgctcgt  
9180

cgtttggtat ggcttcattc agtcccggtt cccaacgata aaggcgagtt acatgatccc  
9240

ccatgttggtg caaaaaagcg gttagctcct tcggtcctcc gatcgttgctc agaagtaagt  
9300

tggccgcagt gttatcactc atggttatgg cagcactgca taattctctt actgtcatgc  
9360

catccgtaag atgcttttct gtgactgggtg agtactcaac caagtcattc tgagaatagt  
9420

gtatgcggcg accgagttgc tcttgcccg cgtcaatacg ggataatacc gcgccacata  
9480

gcagaacttt aaaagtgtc atcattggaa aacgttcttc ggggcgaaaa ctctcaagga  
9540

tcttaccgct gttgagatcc agttcgatgt aaccactcgc tgcacccaac tgatottcag  
9600

catcttttac tttcaccagc gtttctgggt gagcaaaaac aggaaggcaa aatgccgcaa  
9660

aaaagggaat aaggcgaca cggaaatgtt gaatactcat actottcctt tttcaatatt  
9720

attgaagcat ttatcagggt tattgtctca tgagcggata catatttgaa tgtatttaga  
9780

aaaataaaca aataggggtt ccgcgcacat ttccccgaaa agtgccacct gacgtctaag  
9840

aaaccattat tatcatgaca ttaacctata aaaataggcg tatcacgagg ccctttcgtc  
9900

ttcac  
9905

<210> 7  
<211> 10429  
<212> DNA  
<213> Bordetella pertussis - A-CyaA pJR2 plasmid DNA

<400> 7  
ctcgagaaat cataaaaaat ttatttgctt tgtgagcgga taacaattat aatagattca  
60  
attgtgagcg gataacaatt tcacacagaa ttcattaaag aggagaaatt aactatgaga  
120  
ggatcgcatc accatcacca tcacggatcc gcatgcgagc tcggtaccat gcagcaatcg  
180  
catcaggctg gttacgcaaa cgccgccgac cgggagtctg gcatccccgc agccgtactc  
240  
gatggcatca aggccgtggc gaaggaaaaa aacgccacat tgatgttccg cctggtcaac  
300  
ccccattcca ccagcctgat tgccgaaggg gtggccacca aaggattggg cgtgcacgcc  
360  
aagtcgtccg attgggggtt gcaggcgggc tacattcccg tcaaccgaa tctttccaaa  
420  
ctgttcggeg gtgcgccga ggtgatcgcg cgggccgaca acgacgtcaa cagcagcctg  
480  
gcgcatggcc ataccgcggt cgacctgacg ctgtcgaaaag agcggcttga ctatctgcgg  
540  
caagcgggcc tggtcaccgg catggccgat ggcgtggtcg cgagcaacca cgcaggctac  
600  
gagcagttcg agtttcgctg gaaggaaacc tcggacgggc gctatgccgt gcagtatcgc  
660  
cgcaagggcg gcgacgattt cgaggcggtc aaggatgatcg gcaatgccgc cgttattcca  
720  
ctgacggcgg atatcgacat gttcgccatt atgccgcatc tgtccaactt ccgcgactcg  
780  
gcgcgagtt cggtgaccag cggcgattcg gtgaccgatt acctggcgcg cacgcggcgg  
840  
gccgccagcg aggccacggg cggcctggat cgcgaacgca tcgacttggt gtggaaaatc  
900  
gctcgcgccg gcgcccgttc cgcagtgggc accgaggcgc gtcgccagtt ccgctacgac  
960  
ggcgacatga atatcggcgt gatcaccgat ttcgagctgg aagtgcgcaa tgcgctgaac  
1020  
aggcgggcgc acgccgtcgg cgcgcaggac gtggtccagc atggcactga gcagaacaat  
1080  
cctttcccgg aggcagatga gaagattttc gtcgtatcgg ccaccgggtga aagccagatg  
1140  
ctcacgcgcg ggcaactgaa ggaatacatt ggccagcagc gcggcgaggg ctatgtcttc

1200

tacgagaacc gtgcatacgg cgtggcgggg aaaagcctgt tcgacgatgg gctgggagcc  
1260

gcgcccggcg tgccgagcgg acgttcgaag ttctcgccgg atgtactgga aacggtgccg  
1320

gcgtcaccgg gattgcggcg gccgtcgtg ggcgcagtgg aacgccagga ttccggctat  
1380

gacagccttg atgggggtgg atcgcgatcg ttctcgttgg gcgaggtgtc cgacatggcc  
1440

gccgtggaag cggcggaact ggaaatgacc cggcaagtct tgcacgccgg ggcgcggcag  
1500

gacgatgccg agccggggcg gagcggcgcg tcggcgcaact gggggcagcg ggcgctgcag  
1560

ggcgcccagg cgggtggcggc ggcgcagcgg ctggttcatt ccattgccct gatgacgcaa  
1620

ttcgccgggg ccggttcac caacacgccg caggaagcgg cctcgttgtc ggcggccgtg  
1680

ttcggttgg gcgaggccag cagcgccgtg gccgaaaccg tgagcggttt tttccgagg  
1740

tcttcgcgtt gggccggcgg tttcggcgtg gctggcggcg cgatggcgct gggaggcggc  
1800

atcgccgcgg ccgttggcgc cgggatgtcg ttgaccgatg acgcgccggc cggacagaag  
1860

gccgccgcgg gcgccgagat cgcgctgcag ttgacagggt gaacggtcga gctggcttct  
1920

tccatcgctt tggcgctggc cgcggcgcgc ggcgtgacca gcggcttgca ggtggccggg  
1980

gcgtcgcccg gggcggtgc cggcgattg gccgcggcgc tcagtcccat ggagatctac  
2040

ggcctggtgc agcaatcgca ctatcggtat cagctggaca agctggcgca ggaatcgagc  
2100

gcatacgggt acgagggcga cgccttgctg gccagctgt atcgcgacaa gacggccgcc  
2160

gagggcgccg tcgccggcgt ctccgccgtc ctgagcacgg tgggggcggc ggtgtcgatc  
2220

gccgcggcgg ccagcgtggt aggggccccg gtggcggtgg tcacttcctt gctgaccggg  
2280

gctctcaacg gcatcctgcg cggcgtgcag cagcccatca tcgaaaagct ggccaacgat  
2340

tacgctcgca agatcgacga gctgggcggg ccgcaagcgt acttcgagaa aaacctgcag  
2400

gcgcgtcacg aacaactggc caattcggac ggcctacgga aaatgctggc cgacctgcag  
2460

gccggttga acgccagcag cgtgatcggg gtgcagacga cagagatctc caagtcggcg



2520

ctcgaactgg ccgccattac cggcaacgcg gacaacctga aatccgtcga cgtgttcgtg  
2580

gaccgcttcg tccagggcga gcgggtggcc ggccagccgg tggtcctcga cgtcgccgcc  
2640

ggcggcatcg atatcgccag ccgcaagggc gagcggccgg cgctgacgtt catcacgccg  
2700

ctggccgcgc caggagaaga gcagcgccgg cgcacgaaaa cgggcaagag cgaattcacc  
2760

acattcgtcg agatcgtggg caagcaggac cgctggcgca tccgggacgg cgcggccgac  
2820

accaccatcg atctggccaa ggtggtgtcg caactggtcg acgccaatgg cgtgctcaag  
2880

cacagcatca aactggatgt gatcggcgga gatggcgatg acgtcgtgct tgccaatgct  
2940

tcgcgcatcc attatgacgg cggcgcgggc accaacacgg tcagctatgc cgccctgggt  
3000

cgacaggatt ccattaccgt gtccgccgac ggggaacgtt tcaacgtgcg caagcagttg  
3060

aacaacgcca acgtgtatcg cgaaggcgtg gctaccaga caaccgccta cggcaagcgc  
3120

acggagaatg tccaataccg ccattgtcag ctggcccgtg tcgggcaagt ggtggaggtc  
3180

gacacgctcg agcatgtgca gcacatcacc ggccggggccg gcaacgattc gatcaccggc  
3240

aatgcgcacg acaacttcct agccggcggg tcgggcgacg acaggctgga tggcgcgcc  
3300

ggcaacgaca ccctggttgg cggcgagggc caaaacacgg tcacggcgcg cggcgcgac  
3360

gacgtattcc tgcaggacct gggggtatgg agcaaccagc tcgatggcgg cgcgggctc  
3420

gataccgtga agtacaacgt gcaccagcct tccgaggagc gcctcgaacg catgggagac  
3480

acgggcatcc atgccgatct tcaaaagggc acggtcgaga agtggccggc cctgaacctg  
3540

ttcagcgtcg accatgtcaa gaatatcgag aatctgcacg gctcccgcct aaacgaccgc  
3600

atcgccggcg acgaccagga caacgagctc tggggccacg atggcaacga cacgatacgc  
3660

ggccggggcg gcgacgacat cctgcggggc ggcctggggc tggacacgct gtatggcgag  
3720

gacggcaacg acatcttcct gcaggacgac gagaccgtca gcgatgacat cgacggcggc  
3780

gcggggctgg acaccgtcga ctactccgcc atgatccacc caggcaggat cgttgcgccg

3840

catgaatacgc gcttcgggat cgaggcggac ctgtccaggg aatgggtgcg caaggcgtcc  
3900

gcgctgggcg tggactatta cgataatgtc cgcaatgtcg aaaacgtcat cggtagcagc  
3960

atgaaggatg tgctcatcgg cgacgcgcaa gccaatacc tgatgggcca gggcggcgac  
4020

gataccgtgc gggcgggcga cggcgatgat ctgctgttcg gggcgacgg caacgacatg  
4080

ctgtatggcg acgccggcaa cgacaccctc tacggggggc tggcgacga tacccttgaa  
4140

ggcggcgcg gcaacgattg gttcggccag acgcaggcgc gcgagcatga cgtgctgcgc  
4200

ggcgagatg ggggtgatac cgtcgattac agccagaccg gcgcgcatgc cggcattgcc  
4260

gggggtcgca tcgggctggg catcctggct gacctgggcg ccggccgcgt cgacaagctg  
4320

ggcgaggccg gcagcagcgc ctacgatacg gtttcgggta tcgagaacgt ggtgggcacg  
4380

gaactggccg accgcatcac gggcgatgcg caggccaacg tgctgcgcgg cgcgggtggc  
4440

gccgacgtgc ttgcgggcgg cgagggcgac gatgtgctgc tggcgggcga cggcgacgac  
4500

cagctgtcgg gcgacgccgg acgcgatcgc ttgtacggcg aagccggtga cgactggttc  
4560

ttccaggatg ccgccaatgc cggcaatctg ctgcacggcg gcgacggccg cgataccgtg  
4620

gatttcagcg gccggggccg gggcctcgac gccggcgcaa agggcgtatt cctgagcttg  
4680

ggcaaggggt tcgccagcct gatggacgaa cccgaaacca gcaacgtgtt gcgcaatata  
4740

gagaacgccg tgggcagcgc gcgtgatgac gtgctgatcg gcgacgcagg cgccaacgtc  
4800

ctcaatggcc tggcgggcaa cgacgtgctg tccggcgggc ctggcgacga tgtgctgctg  
4860

ggcgacgagg gctcggacct gctcagcggc gatgcgggca acgacgatct gttcggcggg  
4920

cagggcgatg atacttatct gttcggggtc gggtagggc acgacacgat ctacgaatcg  
4980

ggcggcggcc atgacaccat ccgcatcaac gcgggggcgg accagctgtg gttcgcgcgc  
5040

cagggcaacg acctggagat ccgcattctc ggcaccgacg atgcacttac cgtgcacgac  
5100

tggtatcgcg acgccgatca ccgggtggaa atcatccatg ccgccaacca ggcggtagac

5160

caggcaggca tcgaaaagct ggtcgaggca atggcgagct atccggaccc cggcgcgcg  
5220

gcggtgccc cgccggcggc gcgcgtgccg gacacgctga tgcagtcctt ggctgtcaac  
5280

tggcgctgag gatccgaggg catgtcatgc ttccgtccgc ccaagcgccc tccctcctca  
5340

atcccaccga cgacttcgcg gcaactggga atattgcctg gctgtggatg aactctccca  
5400

tgcaccgcca ctggccgggtg catctgctcg cagcaaacac gctcgcgccg attcaactgg  
5460

gccaatatcat tctgctgcca tgcaatgacg tgccgggttg atactgcagc tgggccctaa  
5520

tggacgccga caccgaactc tcctatgtca tggcgccctc gtcgctgggc gggaatgcct  
5580

ggaactgcgg cgaccgactg tggatcatcg actggatcgc gccattctcg cgcgacgaca  
5640

atcgtgcgct gcgcccgcgg ctggccgaac ggcaccccga cagcgtgggc cgttcgctgc  
5700

gcgttcggcg cgccggcgac accgcgcgcg tcaaggagta ccgaggccgc gcgctggacg  
5760

cgccgcccac tcgcgcgag ctggaccgct accatgccga actgatcgca ggactgcgcg  
5820

cgagcaacgg cggtatcgcg ccgcgaggcc ggggcaccgc ctgaaagctt aattagctga  
5880

gcttggactc ctgttgatag atccagtaat gacctcagaa ctccatctgg atttggtcag  
5940

aacgctcggg tgccgccggg cgttttttat tggtgagaat ccaagctagc ttggcgagat  
6000

tttcaggagc taaggagct aaaatggaga aaaaaatcac tggatatacc accgttgata  
6060

tatcccaatg gcatcgtaaa gaacattttg aggcatttca gtcagttgct caatgtacct  
6120

ataaccagac cgttcagctg gatattacgg cttttttaaa gaccgtaaag aaaaataagc  
6180

acaagtttta tccggccttt attcacattc ttgccgcct gatgaatgct catccggaat  
6240

ttcgtatggc aatgaaagac ggtgagctgg tgatatggga tagtggtcac cttgtttaca  
6300

ccgttttcca tgagcaaaact gaaacgtttt catcgctctg gactgaatac cagcagcatt  
6360

tccggcagtt tctacacata tattcgcaag atgtggcgtg ttacggtgaa aacctggcct  
6420

atttccctaa agggtttatt gagaatatgt ttttcgtctc agccaatccc tgggtgagtt

6480

tcaccagttt tgatttaaac gtggccaata tggacaactt ctgcgcccc gttttcacca  
6540

tgggcaaata ttatacgcaa ggcgacaagg tgctgatgcc gctggcgatt caggttcatc  
6600

atgccgtttg tgatggcttc catgtcggca gaatgcttaa tgaattacaa cagtactgcy  
6660

atgagtggca gggcggggcg taattttttt aaggcagtta ttggtgccct taaacgcctg  
6720

gggtaatgac tctctagctt gaggcacaa ataaaacgaa aggctcagtc gaaagactgg  
6780

gcctttcgtt ttatctgttg tttgtcggcg aacgctctcc tgagttaggac aaatccgccc  
6840

tctagattac gtgcagtcga tgataagctg tcaaacatga gaattgtgcc taatgagtga  
6900

gctaacttac attaattgcy ttgcgctcac tgcccgtttt ccagtcggga aacctgtcgt  
6960

gccagctgca ttaatgaatc ggccaacgcy cggggagagg cggtttgcyt attgggcygc  
7020

aggggtggtt ttcttttcac cagtgcgacg ggcaacagct gattgccctt caccgcctgg  
7080

ccctgagaga gttgcagcaa gcggtccacg ctggtttgcc ccagcaggcy aaaatcctgt  
7140

ttgatgggtg ttaacggcgg gatataacat gagctgtctt cggtatcgtc gtatcccact  
7200

accgagatat ccgcaccaac gcgcagcccg gactcggtaa tggcgcgcat tgcgcccagc  
7260

gccatctgat cgttggaac cagcatcgca gtgggaacga tgccctcatt cagcatttgc  
7320

atggtttgtt gaaaaccgga catggcactc cagtcgcctt cccgttcgc tatcggtga  
7380

atttgattgc gagtgagata tttatgccag ccagccagac gcagacgcgc cgagacagaa  
7440

cttaatgggc ccgctaacag cgcgatttgc tggtagacca atgcgaccag atgctccacg  
7500

cccagtcgcy taccgtcttc atgggagaaa ataatactgt tgatgggtgt ctggtcagag  
7560

acatcaagaa ataacgccg aacattagtg caggcagctt ccacagcaat ggcatcctgg  
7620

tcatccagcy gatagttaat gatcagccca ctgacgcgtt gcgcgagaag attgtgcacc  
7680

gccgctttac aggttcgac gccgcttcgt tctaccatcg acaccaccac gctggcacc  
7740

agttgatcgy cgcgagattt aatcgccgcy acaatttgcg acggcgcgtg cagggccaga

7800

ctggaggtgg caacgccaat cagcaacgac tgtttgcccg ccagttgttg tgccacgcgg  
7860

ttgggaatgt aattcagctc cgccatcgcc gttccactt tttcccggt tttcgagaa  
7920

acgtggctgg cctgggtcac cagcgaggaa acggtctgat aagagacacc ggcatactct  
7980

gcgacatcgt ataacgttac tggtttcaca ttcaccaccc tgaattgact ctcttccggg  
8040

cgctatcatg ccataaccgag aaagggtttg caccattcga tgggtgcgga atttcgggca  
8100

gcgttgggtc ctggccacgg gtgcgcatga tctagagctg cctcgcgctg ttcggtgatg  
8160

acggtgaaaa cctctgacac atgcagctcc cggagacggt cacagcttgt ctgtaagcgg  
8220

atgccgggag cagacaagcc cgtcagggcg cgtcagcggg tgttggcggg tgcggggcg  
8280

cagccatgac ccagtcacgt agcgatagcg gagtgtatac tggcttaact atgcggcatc  
8340

agagcagatt gtactgagag tgcaccatat gcggtgtgaa ataccgcaca gatgcgtaag  
8400

gagaaaatac cgcacagggc gctcttcgc ttctctgctc actgactcgc tgcgctcggt  
8460

cgttcggctg cggcgagcgg tatcagctca ctcaaaggcg gtaatacggg tatccacaga  
8520

atcaggggat aacgcaggaa agaacatgtg agcaaaaggc cagcaaaagg ccaggaaccg  
8580

taaaaaggcc gcgttgcctg cgtttttcca taggtctcgc cccctgacg agcatcaca  
8640

aaatcgacgc tcaagtcaga ggtggcgaaa cccgacagga ctataaagat accaggcggt  
8700

tccccctgga agtccctcg tgcgctctcc tgttccgacc ctgccgtta ccggatacct  
8760

gtccgccttt ctcccttcgg gaagcgtggc gctttctcat agctcacgct gtaggtatct  
8820

cagttcggtg taggtcgttc gctccaagct gggctgtgtg cacgaacccc ccgttcagcc  
8880

cgaccgctgc gccttatccg gtaactatcg tcttgagtcc aaccggtaa gacacgactt  
8940

atcgccactg gcagcagcca ctggtaacag gattagcaga gcgaggtatg taggcggtgc  
9000

tacagagttc ttgaagtggg ggcctaacta cggctacact agaaggacag tatttggtat  
9060

ctgcgctctg ctgaagccag ttaccttcgg aaaaagagtt ggtagctctt gatccggcaa

9120

acaaaccacc gctggtagcg gtggtttttt tgtttgcaag cagcagatta cgcgagaaa  
9180

aaaaggatct caagaagatc ctttgatctt ttctacgggg tctgacgctc agtggaaacga  
9240

aaactcacgt taagggattt tggatcatgag attatcaaaa aggatcttca cctagatcct  
9300

tttaaattaa aaatgaagtt ttaaataaat ctaaagtata tatgagtaaa cttggtctga  
9360

cagttaccaa tgcttaatac gtgaggcacc tatctcagcg atctgtctat ttogttcatc  
9420

catagttgcc tgactccccg tcgtgtagat aactacgata cgggagggct taccatctgg  
9480

ccccagtgt gcaatgatac cgcgagacc acgtcacccg gctccagatt tatcagcaat  
9540

aaaccagcca gccggaagg cggagcgcag aagtggctct gcaactttat ccgcctccat  
9600

ccagtctatt aattggtgcc gggaaagctag agtaagtagt tcgccagtta atagtttgcg  
9660

caacgttggt gccattgcta caggcatcgt ggtgtcacgc tcgtcgtttg gtatggcttc  
9720

attcagctcc ggttcccaac gatcaaggcg agttacatga tccccatgt tgtgcaaaaa  
9780

agcggttagc tccttcggtc ctccgatcgt tgtcagaagt aagttggccg cagtgttatc  
9840

actcatgggt atggcagcac tgcataatc tcttactgtc atgccatccg taagatgctt  
9900

ttctgtgact ggtgagtact caaccaagtc attctgaga tagtgtatgc ggcgaccgag  
9960

ttgtctttgc ccggcgtcaa tacgggataa taccgcgcca catagcagaa ctttaaaagt  
10020

gtcatcatt ggaaaacggt ctctggggcg aaaactctca aggatcttac cgctgttgag  
10080

atccagttcg atgtaaccca ctggtgcacc caactgatct tcagcatctt ttactttcac  
10140

cagcgtttct gggtagcaaa aaacaggaag gcaaaatgcc gcaaaaaagg gaataagggc  
10200

gacacggaaa tgttgaatac tcatactctt cttttttcaa tattattgaa gcatttatca  
10260

gggttattgt ctcatgagcg gatacatatt tgaatgtatt tagaaaaata aacaaatagg  
10320

ggttcgcgc acatttcccc gaaaagtgcc acctgacgct taagaaacca ttattatcat  
10380

gacattaacc tataaaaaata ggcgtatcac gaggcccttt cgtcttcac

10429

<210> 8  
<211> 31  
<212> DNA  
<213> artificial sequence  
  
<220>  
<223> oligonucleotide PAB5  
  
<400> 8  
cgccggtacc atgcagcaat cgcatcaggc t  
31

<210> 9  
<211> 21  
<212> DNA  
<213> artificial sequence  
  
<220>  
<223> oligonucleotide PAB6  
  
<400> 9  
tgggtgaattc gctcttgccc g  
21

<210> 10  
<211> 25  
<212> DNA  
<213> artificial sequence  
  
<220>  
<223> oligonucleotide PAB7  
  
<400> 10  
aagagcgaat tcaccacatt cgtcg  
25

<210> 11  
<211> 29  
<212> DNA  
<213> artificial sequence  
  
<220>  
<223> oligonucleotide PAB2  
  
<400> 11  
cgcggtacct cagcgccagt tgacagcca  
29

<210> 12  
<211> 35  
<212> DNA  
<213> artificial sequence  
  
<220>  
<223> oligonucleotide PAB3  
  
<400> 12  
cgcggtaccg agggcatgtc atgcttccgt ccgcc  
35

<210> 13  
<211> 30  
<212> DNA  
<213> artificial sequence

<220>  
<223> oligonucleotide PAB4

<400> 13  
cgcggcgaag ctttcaggcg gtgccccggc  
30

<210> 14  
<211> 23  
<212> DNA  
<213> Artificial sequence

<220>  
<223> oligonucleotide pUC forward

<400> 14  
cccagtcacg acgttgtaaa acg  
23

<210> 15  
<211> 43  
<212> DNA  
<213> artificial sequence

<220>  
<223> oligonucleotide PAB27

<400> 15  
caacccccaa tcggatcccg cgcgggccac gcccaatcct.ttg  
43

<210> 16  
<211> 43  
<212> DNA  
<213> artificial sequence

<220>  
<223> oligonucleotide PAB17

<400> 16  
caaaggattg ggcgtggccg ccgcgggatc cgattggggg ttg  
43

<210> 17  
<211> 23  
<212> DNA  
<213> artificial sequence

<220>  
<223> oligonucleotide PAB29

<400> 17  
cgtagatctc catgggactg agc  
23



<210> 18

<211> 15

<212> DNA

<213> artificial sequence

<220>

<223> phosphoro-thioate-stabilised oligodeoxynucleotide-containing  
CpG

motifs CpG-ODN

<400> 18

gctagacgtt agcgt

15